TABLE OF CONTENTS

| SECTION A: NORTH CAROLINA WATER QUALITY ISSUES | 1 |
|---|----|
| A-1 POINT SOURCE POLLUTION | |
| Controlling Point Source Pollution | |
| • Wastewater | |
| ♦ Stormwater | |
| A-2 NONPOINT SOURCE POLLUTION | 3 |
| Types of Nonpoint Source Pollution | |
| Sources of Nonpoint Source Pollution | |
| Agricultural Operations | |
| | |
| Timber Harvesting | |
| Construction Activities | |
| Solid Waste Disposal | |
| Golf Courses | |
| Mining Activities. | |
| | |
| SECTION B: AN OVERVIEW OF POLLUTANTS AND WATER QUALITY IMPACTS | 9 |
| B-1 SEDIMENT | 9 |
| Sedimentation | 10 |
| Sediment and Streamflow | 10 |
| ♣ The Effects of Urbanization on Streamflow, Storm Flows and Sediment | |
| Sediment and Streambank Erosion | |
| Stream Modification | |
| How Does Sediment Affect Water Quality? | |
| REDUCING WATER QUALITY IMPACTS FROM SEDIMENT | |
| Streambank Erosion and Loss of Riparian Vegetation | |
| Using Riparian Buffers to Protect Stream Quality and Integrity | |
| Streambank Fencing and Alternative Livestock Water Supply | |
| Construction Activities and Sedimentation | |
| New Rules Regarding Sediment Control | |
| Private Access Road Construction | |
| For More Information. | |
| NC Sedimentation Control Program | |
| B-2 FECAL COLIFORM BACTERIA | |
| How Does Fecal Coliform Bacteria Affect Water Quality? | |
| Standards Applied to Protect Public Health | |
| Fecal Coliform and Shellfish Harvesting | |
| REDUCING WATER QUALITY IMPACTS FROM FECAL COLIFORM BACTERIA | |
| Managing Fecal Coliform Bacteria in Shellfish Waters | |
| Development Thresholds | |
| Construction, Stormwater and Land Use Issues | |
| | |
| A State and Local Interaction through CΔMΔ | 23 |

| Animal Waste Management | 25 |
|---|----------|
| B-3 NUTRIENTS | 26 |
| How do Nutrients Affect Water Quality? | 26 |
| Reservoir and Lake Eutrophication | 27 |
| REDUCING WATER QUALITY IMPACTS FROM NUTRIENTS | 28 |
| Nutrient Sensitive Waters Classification | |
| | |
| Neuse River Nutrient Sensitive Waters Management Strategy | |
| Phosphate Detergent Ban | 30 |
| B-4 OXYGEN-CONSUMING WASTES | 31 |
| How do Oxygen-Consuming Wastes Affect Water Quality? | 31 |
| Factors Affecting Dissolved Oxygen. | 31 |
| REDUCING WATER QUALITY IMPACTS FROM OXYGEN-CONSUMING WASTES | 32 |
| Modeling | |
| NPDES Permit Limits | |
| Discharges to Zero and Low Flow Streams | |
| Discharges to Swamp Waters | |
| B-5 TOXIC SUBSTANCES | 36 |
| pH | |
| Metals | |
| Chlorine | |
| Ammonia (NH ₃) | |
| REDUCING WATER QUALITY IMPACTS FROM TOXIC SUBSTANCES | |
| pH | |
| Metals | |
| Chlorine | |
| Ammonia | |
| Whole Effluent Toxicity Testing at NPDES Facilities | 39 20 |
| NPDES Permit Limits | |
| | |
| Nonpoint Source Controls | |
| B-6 COLOR | |
| How Does Color Affect Water Quality? | |
| REDUCING WATER QUALITY IMPACTS FROM COLOR | |
| DWQ Color Reduction Strategy | |
| SECTION C: DWQ WATER QUALITY PROTECTION AND RESTORATION PROGRAM | IS44 |
| C-1 BASINWIDE PLANNING | |
| | |
| Basinwide Responsibilities within DWQ's Water Quality Section | |
| Environmental Sciences Branch | |
| Point Source Branch | |
| Non-Discharge Branch | |
| Basinwide Planning Goals | |
| Benefits of the Basinwide Approach | |
| Basinwide Plan Schedule | |
| Basinwide Plan Preparation, Review and Public Involvement | |
| How to Get Involved | |
| Conclusions | |
| For More Information. | |
| 2 V2 1/10/10 1111/1/1114/1/1/1/1/1/1/1/1/1/1/1/1/1/1 | |

| C-2 NONPOINT SOURCE PROGRAMS | 51 |
|---|----|
| Section 319 Program | |
| For More Information. | 53 |
| Non-Discharge Permits | 53 |
| Animal Waste Management | 54 |
| For More Information. | |
| Urban And Developing Areas Program | |
| For More Information. | |
| State Stormwater Management Programs | |
| | |
| Coastal Nonpoint Pollution Control Programs | |
| Coastal Stormwater Management | |
| Water Supply Protection Program | |
| For More Information. | |
| Wetlands Certification Program | |
| Section 401 Water Quality Certification (from CWA) | |
| North Carolina Dredge and Fill Act (1969) | |
| For More Information. | |
| Groundwater Program | |
| Well Construction Program | |
| Non-Discharge Program | |
| Compliance Monitoring Program. | |
| Underground Injection Control Groundwater Rules | |
| For More Information. | |
| C-3 CLASSIFICATIONS AND STANDARDS | |
| | |
| Water Quality Standards | |
| Statewide Classifications | |
| High Quality Waters Outstanding Resource Waters | |
| For More Information. | |
| C-4 WATER QUALITY MONITORING | |
| | |
| Benthic Macroinvertebrate Monitoring | |
| Fish Monitoring | |
| Lakes Assessment Program (including Phytoplankton) | |
| Aquatic Toxicity Monitoring | |
| Sediment Oxygen Demand | |
| Ambient Monitoring System | |
| For More Information | |
| C-5 USE SUPPORT RATINGS | 76 |
| Interpretation of Data | 76 |
| Assessment Methodology - Freshwater Streams | 77 |
| Monitoring Data | |
| Chemical/Physical Data | |
| Sources and Cause Data | |
| ♦ Outside Data | |
| Monitored vs. Evaluated | |
| Assigning Use Support Ratings to Freshwater Streams | |
| Assessment Methodology - Lakes | |
| Assessment Methodology - Saltwater Bodies | |
| DEH Sanitary Surveys | |
| Chemical/Physical Data | |
| ♣ Phytoplankton and Algal Bloom Data | 83 |

| Assigning Saltwater Use Support Ratings | 84 |
|---|-----|
| Revisions to Methodology Since 1992-93 305(b) Report | |
| 303(d) Listing and Reporting Requirements | |
| • What is the 303(d) List? | |
| ◆ 303(d) List Development | |
| Sources of Information | |
| For More Information | |
| C-6 POINT SOURCE PROGRAMS | 87 |
| NPDES Wastewater Discharge Permits | |
| ↑ NPDES Permit Review and Processing | |
| ◆ Wasteload Allocation Modeling | |
| Pretreatment Program | |
| • Operator Certification and Training | |
| Non-Discharge and Regional Wastewater Treatment Alternative | |
| For More Information | |
| C-7 UNIFIED WATERSHED ASSESSMENT | 91 |
| For More Information | 91 |
| C-8 ALBEMARLE-PAMLICO NATIONAL ESTUARY PROGRA | |
| For More Information | |
| C-9 WETLANDS RESTORATION PROGRAM | |
| For More Information | |
| | |
| SECTION D: FEDERAL AND OTHER STATE WATER QUALIT | |
| MANAGEMENT PROGRAMS | 97 |
| D-1 FEDERAL PROGRAMS | 97 |
| US Forest Service | |
| For More Information. | |
| US Fish and Wildlife Service | |
| For More Information. | |
| US Army Corps of Engineers | |
| For More Information. | |
| US Department of Agriculture NRCS | |
| Food Security Act of 1985 (FSA) and the Food, Agriculture, | |
| Conservation and Trade Act of 1990 (FACTA) | 99 |
| For More Information | |
| D-2 STATE PROGRAMS | 104 |
| NC Division of Soil and Water Conservation | |
| North Carolina Agriculture Cost Share Program | |
| For More Information | |
| NC Department of Agriculture and Consumer Services | |
| North Carolina Pesticide Law of 1971 | |
| Soil, Plant Waste and Solution Advisory Programs | |
| For More Information | |
| NC Division of Forest Resources | 106 |
| Forest Practice Guidelines Related to Water Quality | |
| ♣ Forest Management Program | |
| Forest Stewardship Program | |
| For More Information | |
| NC Wildlife Resources Commission | |
| For More Information | |
| NC Division of Land Resources | 108 |
| For More Information | 109 |
| | |

| NC Division of Waste Management | 109 |
|--|------------|
| Local Program | 110 |
| For More Information. | 110 |
| NC Division of Environmental Health | 110 |
| For More Information | |
| NC Division of Water Resources | 111 |
| ↑ Water Supply Planning Law | 111 |
| Registration of Water Withdrawals and Transfers Law | 111 |
| ♠ Regulation of Surface Water Transfers Act | |
| Capacity Use Act | 112 |
| ♠ Dam Safety Law | 113 |
| For More Information. | |
| NC Division of Coastal Management | 113 |
| Coastal Nonpoint Pollution Control Programs | 113 |
| CAMA Land Use Plans | 113 |
| For More Information. | |
| NC Division of Marine Fisheries | 114 |
| For More Information | 114 |
| NCSU Cooperative Extension Service | 114 |
| Agricultural Research Service | |
| For More Information. | |
| | |
| ECTION E - WATER QUALITY PROJECT FUNDING SOURCES | 117 |
| E-1 DENR FUNDING PROGRAMS | 117 |
| Section 319 | |
| Clean Water Management Trust Fund | |
| NC Wetlands Restoration Program | |
| E-2 FUNDING SOURCES FOR POINT SOURCE POLLUTION PROJECTS | |
| | |
| Federal | |
| State | |
| Private | |
| E-3 FUNDING SOURCES FOR NPS POLLUTION PROJECTS | |
| Agriculture | |
| Education | 123 |
| Research | 124 |
| Water Quality Planning | 125 |
| Forestry, Reclamation and Land Conservation | |
| • | |
| PPENDIX 1 - FEDERAL AND STATE AUTHORITIES FOR | |
| NC WATER QUALITY PROGRAMS | 128 |
| Federal Authorities For North Carolina's Water Quality Program | 130 |
| State Authorities For North Carolina's Water Quality Program | |
| | 130 |
| PPENDIX 2 - BEST MANAGEMENT PRACTICES (BMPS) FOR | |
| CONTROLLING NPS POLLUTION | 132 |
| 1 DMD, EOD ACDICHI THDE | 124 |
| 1. BMPs FOR AGRICULTURE | |
| DMD, Ell's llele fee Oest Olese Deserves 4 | |
| BMPs Eligible for Cost Share Payments | |
| Purpose: Sediment/Nutrient Delivery Reduction From Fields | |
| Purpose: Sediment/Nutrient Delivery Reduction From Fields | 136 |
| Purpose: Sediment/Nutrient Delivery Reduction From Fields | 136 136 |

| 2. BMPs FOR URBAN STORMWATER | 138 |
|--|-----|
| Structural BMPs | 138 |
| Nonstructural BMPs | 138 |
| Substitutions for Household Hazardous Substances | 138 |
| Recommendations for Urban Stormwater Control | 139 |
| 3. BMPs FOR EROSION AND SEDIMENTATION CONTROL | 140 |
| 4. BMPs FOR ON-SITE WASTEWATER DISPOSAL | 142 |
| 5. BMPs FOR SOLID WASTE MANAGEMENT | 144 |
| 6. BMPs FOR FORESTRY | 146 |
| A. Performance Standards for Forestry Site Disturbing Activities in North Carolina | 146 |
| B. BMPs for Forestry Operations in Wetlands | 146 |
| 7. BMPs FOR MINING OPERATIONS | 148 |
| 8. BMPs FOR HYDROLOGIC MODIFICATION (RELATED TO MINING OPERATIONS) | 150 |
| APPENDIX 3 - GLOSSARY | 152 |
| REFERENCES | 162 |

SECTION A: NORTH CAROLINA WATER QUALITY ISSUES

Human activities can impact water quality, even when they occur some distance away from a surface waterbody. While any one activity may not have a noticeable affect on water quality, the cumulative impacts of all land use activities in a watershed can be significant and long lasting.

Every person living near or visiting a watershed contributes to that impact. Because pollutants from human activities enter surface waters through either point or nonpoint sources, it is important to be aware of our contributions and to act to reduce them. With proper management of wastes and land use activities, these impacts can be minimized.

A-1 POINT SOURCE POLLUTION



Point source (PS) pollution refers to a discharge that enters surface waters through a pipe, ditch or other discrete, well-defined location. The primary point source pollutants are oxygen-consuming wastes, nutrients, color and toxic substances including chlorine, ammonia and metals.

Point source pollution applies primarily to wastewater and stormwater discharges from municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that serve schools, commercial offices, residential subdivisions and individual homes.

CONTROLLING POINT SOURCE POLLUTION

↑ WASTEWATER

Point source dischargers in North Carolina must apply for, and obtain, a National Pollutant Discharge Elimination System (NPDES) permit from the state. Discharge permits are issued under the NPDES program as delegated to the NC Division of Water Quality (DWQ) by the US Environmental Protection Agency (EPA). Refer to Section C-7 on page 81 for more information.



Encarta Encyclopedia Online

4 STORMWATER

The primary source of concern regarding industrial facilities is the contamination of stormwater from contact with exposed materials. In addition, poor housekeeping can lead to significant contributions of sediment and other water quality pollutants.



North Carolina currently has a multiphased stormwater-permitting program that addresses stormwater from a variety of sources.

Phase I applies to activities in municipal areas with populations greater than 100,000; ten categories of industrial activity and construction sites greater than 5 acres.

Phase II covers activities in small municipalities (defined as central places with populations greater than 50,000 or population densities greater than 1,000 people/mi²); in urbanized areas or municipalities with populations greater than 10,000 or population densities greater than 1,000 people/mi²; construction sites greater than 1 acre and municipal industrial sites.

To address these issues, Municipal Phase 2 of the NC NPDES Program sets forth the following six minimum control measures:

- 1. Public education and outreach
- 2. Public involvement/participation
- 3. Illicit discharge detection and elimination
- 4. Construction site stormwater runoff control
- 5. Post-construction stormwater management
- 6. Pollution prevention/good housekeeping

In addition, NPDES-permitted facilities must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities or activities identified as having the potential to impact water quality are also required to perform analytical monitoring to characterize the pollutants in their stormwater discharge.

A-2 NONPOINT SOURCE POLLUTION



Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater, snowmelt or atmospheric deposition (e.g., acid rain). The majority of water quality problems in North Carolina are the result of nonpoint source pollution.

There are many types of land use activities that contribute to nonpoint source pollution including land development, construction, forestry operations, mining operations, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots.

Although stormwater from many municipalities, construction sites and municipal industrial sites are considered a point source - since NPDES permits are required for piped discharges of stormwater from these areas - a discussion of urban runoff is included in this section.

TYPES OF NONPOINT SOURCE POLLUTION

Sediment and nutrients are major pollution-causing substances associated with NPS pollution. Others include fecal coliform bacteria, heavy metals, oil and grease and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters.

Unlike point source pollution, nonpoint source pollution is diffuse in nature and can occur intermittently, depending on rainfall.

| Activity | Pollution Source | Solution |
|---|--|--|
| Land clearing or plowing | Erosion Sedimentation | Contour plowing Terracing Conservation tillage Grassed waterways Vegetated buffer between fields and streams |
| Pesticides and fertilizers (including chemical fertilizers and animal wastes) | NutrientsPesticides | Integrated crop and pest managementSoil testing |
| Construction of drainage ditches on poorly drained soils | Enhanced runoff | Maintaining natural stream channelsVegetated buffers |
| Concentrated animal feed lot operations and dairy farms | Oxygen-consuming wastesFecal coliform bacteriaSedimentNutrients | Fencing cattle and dairy cows from streamsNondischarging animal waste lagoons |



SOURCES OF NONPOINT SOURCE POLLUTION

This section contains a brief description of the major sources of nonpoint sources of pollution.

AGRICULTURAL OPERATIONS



Agricultural activities that may cause water quality impacts include

confined animal facilities, grazing, plowing, stream access, pesticide spraying, irrigation, fertilizing, planting and harvesting.

The major agricultural NPS pollutants that result from these activities are sediment, nutrients, pathogens, pesticide and salts. Agricultural activities can also damage habitat and stream channels.

↑ URBAN AREAS



Natural streams with forested watersheds and vegetated riparian zones

experience little overland runoff most rainfall percolates through the soil and enters the groundwater. Therefore, natural streamflow is primarily the result of groundwater inputs.

In urban areas, however, natural vegetation is replaced with paved surfaces and streamside buffers are often removed. In addition, managed lawns reduce the ability of the watershed to filter pollutants before they enter a stream. In other words, urbanization increases the amount - and decreases the quality - of stormwater runoff.

Studies have demonstrated that a serious decline in the quality of receiving waters can occur when only 10 to 15 percent of a watershed is covered by impervious surfaces such as roads, roof tops and parking lots (Schueler, 1994).

While it is widely known that urban streams are often polluted, there are still a number of issues that need to be addressed, such as the specific aspects of urbanization that cause degradation, the extent to which urbanization alone is responsible for degradation and how to change human habits and reduce the amount of pollutants that cause the degradation (Mulholland and Lenat, 1992).

There is also abundant information on the effects of urban runoff on macroinvertebrates. Studies show that stream organisms are affected not only by water quality, but also by the character of the physical habitat such as flow regime (Lenat and Eagleson, 1981; Crawford and Lenat, 1989).

Urban development often involves the use of flood prevention structures that route water directly to streams. This is especially true in urban landscapes where large amounts of impervious surfaces promote overland flow at the expense of groundwater recharge. Flood prevention structures often cause streamflows to rapidly increase after rainfall events, which can lead to bottom scour - the physical movement of bedload - and the disruption of stream biology and habitat.



One of the long-term results of increased overland flow is an accentuated summer low flow, due primarily to a reduction in groundwater storage. Many streams in developed areas even stop flowing during summer months, severely limiting the diversity of aquatic fauna.

In addition, because most fish and macroinvertebrates in streams require flowing water, they may be adversely affected by either extreme high or low flows. Urban development may affect streamflow by increasing flow variability and/or by altering base streamflow.

Due to the chronic introduction of pollutants found in urban stormwater, along with an increase in both the velocity and flow of urban stormwater into streams, attention to stormwater control in urban areas is most important

↑ TIMBER HARVESTING

are an ideal land cover for water quality protection because they stabilize soil, filter rainfall runoff and produce minimal loading of organic matter to waterways. In addition, forested stream buffers filter impurities in runoff from adjoining, nonforested areas.

Undisturbed forested areas

Inappropriate forest management practices, however, can have significant impacts upon water quality. Some adverse effects that can result from poor forestry operations include: 1) destabilization of the streambank; 2) loss of riparian

vegetation which can reduce shade cover and raise stream temperatures; and 3) loss of canopy which can alter the interface of the aquatic and terrestrial ecosystems.

This is especially true where populations of amphibians are concerned.

Sedimentation due to forestry practices is most often associated with the construction and use of logging roads, particularly when roads are built near streams (Waters, 1995). The construction of stream crossings, skid trails and decks can also increase downstream sedimentation. Density and length of logging roads are the major factors in the amount of sedimentation produced.

Because improper timber harvesting can destroy buffers and destabilize soils, forestry Best Management Practices (BMPs) that minimize sediment loss and runoff must be implemented during timber harvest. This is especially true in mountainous regions where steep slopes and fragile soils are widespread.

Without proper BMPs, large clearcutting operations can alter the hydrology of an area and significantly increase the rate and flow of stormwater runoff. This can result in downstream flooding and streambank erosion (Waters, 1995).

← CONSTRUCTION ACTIVITIES

Construction activities that entail excavation, grading or filling (such

as road construction or land clearing



for development) can produce significant sedimentation if not properly controlled. Sedimentation from developing urban areas can be a major source of pollution due to the cumulative number of acres disturbed within a basin. While construction activities are typically a temporary pollution source, their impacts upon water quality can be severe and long lasting.

↑ Solid Waste Disposal



Solid waste includes household wastes, commercial or industrial

wastes, refuse or demolition waste and infectious or hazardous wastes. The improper disposal of these wastes can serve as a primary source for a wide array of pollutants.

The two major water quality concerns associated with modern solid waste facilities are: 1) leachate control and 2) stabilization of the soils used to cover many disposal facilities. When properly designed, constructed and operated, facilities should not significantly affect water quality.

↑ On-SITE WASTEWATER TREATMENT

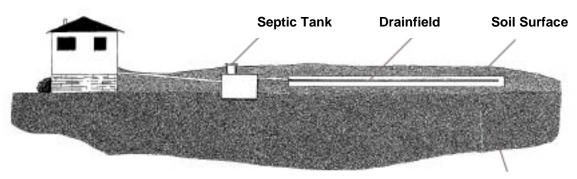


More than 52 percent of all housing units in North Carolina are served by on-

site wastewater systems. Most onsite wastewater treatment systems are conventional septic systems that consist of a tank, a distribution box and a series of subsurface absorption lines with perforated pipes laid in a bed of gravel.

In a septic system, solids are converted to liquids and gases by bacteria in the tank. When the liquid within the tank rises to a certain level, it enters the drainage system through an outflow pipe. This outflow, or effluent, is then distributed throughout the drainfield through a series of subsurface pipes. Final treatment of the effluent occurs as the soil absorbs and filters the liquid, and as microbes break down the rest of the waste into harmless material.

The septic system provides a natural method of treatment and disposal of household wastes for homes that are not part of a municipal sewage



A Septic System

North Carolina Cooperative Extension Service

Soil beneath Drainfield



system. Septic systems can be a safe and effective method for treating wastewater as long as they are sized, sited and maintained properly. Advanced on-site wastewater systems utilize pretreatment methods such as filters and aerobic treatment and use improved distribution systems such as pressure dosing on sensitive sites.

Pollutants associated with on-site wastewater disposal are often associated with discharges to surface waters through straight pipes. Straight pipes are illegal and must either be eliminated, or permitted under the state NPDES program.

All subsurface wastewater treatment and disposal systems are under the jurisdiction of the Commission for Health Services (CHS). The CHS establishes the rules for on-site sewage systems that are administered by the Division of Environmental Health through local health departments.

→ GOLF COURSES

Golf courses may impact
water quality in three
ways. First, erosion can
occur during construction of the golf
course. Second, intensive turf
management practices often rely
heavily on the use of fertilizers and
chemicals. Runoff from golf courses
can carry these pollutants to nearby
streams, impacting aquatic life and
habitat. Golf courses also impact
water quality when stream channels
are altered or cleared of vegetation
during construction and site
maintenance.

► MINING ACTIVITIES



Mining operations, if not properly conducted, can produce highly localized

stream sedimentation. The North Carolina Mining Act of 1971 applies to all persons or firms involved in any activity or process that disturbs or removes surface soil for the purpose of removing minerals or other solid matter. The Act also applies to activities that prepare, wash, clean or in any way treat minerals or other solid materials in order to make them suitable for commercial, industrial or construction use.

While mining operations range from large quarries to small borrow pits; the NC Mining Act applies only to those operations that impact one acre or more.

Some of the problems associated with malfunctioning septic systems include:

Polluted groundwater:

Septic system pollutants include bacteria, nutrients, toxic substances and oxygenconsuming wastes. Nearby wells can become contaminated by these pollutants.

Polluted surface water:

Groundwater can carry pollutants into surface waters where they can harm aquatic ecosystems. Septic tanks can also leak into surface waters through, or over, the soil.

Human health risks:

Malfunctioning septic systems can endanger human health by contaminating nearby wells, drinking water supplies and fishing and swimming areas.





Section B: An Overview of Pollutants and Water Quality Impacts

Section A of this document described a number of pollution sources and the various pathways that pollutants take to enter surface waters in North Carolina. This section discusses the six major pollutant types that affect North Carolina's surface waters. For each type, the following information is provided:

- A description of the pollutant
- An explanation of how the pollutant affects water quality

B-1 SEDIMENT



Weather and erosion affect the surface of the land. When rocks are weathered, they are broken down at the surface of the earth either chemically (through the alteration or dissolution of a mineral) or physically (through the fragmentation of rocks by physical processes such as wind).

Erosion is the natural process through which sediment - the product of weathering - is carried away by rain, wind and ice. As weathered material is transported (eroded), it may change size, shape and composition.

| Dellutent Type | Source Index | | Drimony Courses | |
|-------------------------------|--|-----|--|--|
| Pollutant Type | PS | NPS | Primary Sources | |
| Sediment | _ | ø | Most land-disturbing activities including construction and mining sites, disturbed land areas, streambank erosion, cultivated farmland and removal of vegetative buffers along streams | |
| Fecal Coliform Bacteria | = | * | Failing septic tanks and leaking sewers, animal waste, runoff from livestock operations, wildlife and improperly disinfected wastewater effluent | |
| Nutrients | ☆ | * | Fertilizer (on agricultural, residential, commercial and recreational lawns), animal wastes, leaky sewers and septic tanks, atmospheric deposition and municipal wastewater | |
| Oxygen-Consuming Wastes | ☆ | = | Wastewater effluent, decaying organic matter, leaking sewers and septic tanks and animal waste | |
| Toxic Substances | = | = | Pesticides, disinfectants (chlorine), automobile fluids, urban stormwater and heavy metals | |
| Color | ☆ | _ | Generally associated with industrial wastewater or municipal plants that receive certain industrial wastes, especially textile manufacturers that dye fabrics and pulp and paper mills | |
| | PS = Point Source NPS = Nonpoint Source | | | |
| ★ = significant or primary so | ★ = significant or primary source = limited source that may be locally significant — = little or no contribution | | | |

Some of the adverse water quality impacts of sediment include:

Damaged aquatic communities:

Sediment damages aquatic life by destroying stream habitat, clogging fish gills and reducing water clarity.

Polluted water:

Sediment often carries other pollutants including nutrients, bacteria and toxic/synthetic chemicals. Pollution can also threaten public health if it contaminates drinking water sources or fish tissue.

Increased costs for treating drinking water:

Water with large amounts of sediment requires costly filtration to make it suitable for drinking. In addition, water supply reservoirs lose storage capacity when they become filled with sediment, necessitating expensive dredging efforts.

Although natural weathering and erosion occur on geologic time scales, both can be greatly accelerated when human activities alter the landscape.

SEDIMENTATION

The intertwined processes of weathering and erosion are closely tied to the ways in which wind, water and ice work to transport sediment.

Sedimentation - the deposition of sediment - begins where sediment transport ends, usually in a surface waterbody such as a stream, river or estuary.

Stream sedimentation occurs in three basic stages: 1) transportation of sediment to a stream channel; 2) movement of sediment through the channel network; and 3) deposition of sediment. The amount of sediment that ultimately enters a stream depends primarily upon storm characteristics and soil conditions. One storm may cause only a small percentage of eroded material to enter a stream while another may transport large quantities of sediment.

SEDIMENT AND STREAMFLOW

Sediment transport within a stream is often divided into two categories: suspended load and bedload.

Suspended load is composed of small particles that remain in suspension in the water. Bedload is composed of larger particles that slide or roll along the stream bottom.

The suspension of particles depends on water velocity and stream characteristics. Biologists are primarily concerned with the concentration of the suspended sediments and the degree of sedimentation on the streambed (Waters, 1995).

The movement of sediment through a stream channel network is a function of past and present land use activities. Under many conditions, the amount of sediment carried by a stream will increase as erosion in the watershed increases, and decline as watershed erosion decreases.

A stream has only a finite capacity for transporting sediment, and once the supply of sediment exceeds the capacity of the stream to carry it, any additional sediment that enters the stream will be deposited in channels and on floodplains, rather than carried out of the watershed. Just as on land, stored deposits can be remobilized into the stream system years, or even decades, later.

The vast majority of sediment transport in a stream occurs during periods of high flow. The relationship between sediment load and the ability of a stream to transport sediment directly affects habitat type, channel morphology and bedload particle size.

Storm flows are also important in determining the rate of bank erosion and channel migration. Increased bank erosion and channel migration can affect the riparian vegetation and increase the amount of active sediment in the stream channel.



As the amount of paved surfaces in a developing watershed increases, stormwater flows and direct impacts to streams increase. Water that runs off impervious areas such as roads and parking lots can contain contaminants such as oil, garbage, sand and salt that often go directly into streams.

Research has established that degradation of stream water quality often becomes significant once watershed development exceeds 10-15 percent impervious cover (Schueler, 1994).

Increased storm flows due to urbanization have also been shown to cause rapid channel erosion and a decline in fish habitat quality. For example, runoff from heated roads and parking lots after summer storms can cause rapid increases in stream temperatures that can produce thermal shock and death in many fish.

Changes in storm flow can also have important consequences for human life and property. Bridges, dams and levees, for example, are designed according to a presumed distribution of peak storm flow. If the size of the peak flow is increased, the structure's safety factor may be reduced with more frequent and severe damage possible.

SEDIMENT AND STREAMBANK EROSION

Streambank erosion is a significant source of sediment loading to streams. Streambanks erode due to the clearing of instream obstacles or streamside vegetation, livestock trampling or higher than normal floods (resulting from increased impervious surfaces).

Streambank soil type and composition, vegetation type and vegetation density affect streambank stability. A change in any one of these factors may be reflected in the size and shape of the stream channel, including the bank itself.

Streambank stability, or how a streambank changes over time, is an important indicator of watershed conditions. Unstable steambanks can contribute sediment to a stream channel through streambank slumps and surface erosion. Because all of the material from an eroding streambank is delivered directly to the stream channel, the impacts of an eroding streambank may be much greater than those of a comparable area of eroding hillside.

STREAM MODIFICATION

Natural streams around the world have certain physical characteristics in common, regardless of their location or geologic condition. One of the most important of these characteristics is the bankfull stage. The bankfull stage is the flow at which channel maintenance is most effective, or the discharge that results in the average size and shape of a channel.

Activities that Increase Sediment Loads

- · Construction activities
- Unpaved private access roads
- Road construction
- Golf courses
- Uncontrolled urban runoff
- Mining
- Timber harvesting
- Agriculture
- Livestock operations

Urbanization Can Impact Streams in the Following Ways:

- increased flow & velocity of runoff
- the loss of specialized habitats such as pools and riffles
- decreased instream water quality
- increased stream temperatures
- decreased diversity of aquatic insect and fish populations

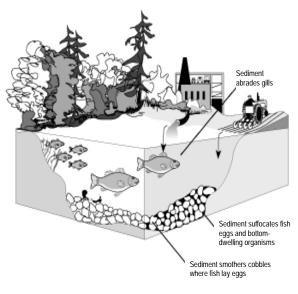


Almost all natural streams have a bankfull stage with a recurrence interval of 1-1.5 years. This means that stream channels that have not been channelized or manipulated by human activities do not have the capacity to carry a 2-year storm without overflowing. In these natural streams, flows larger than a typical annual event are generally carried in both the channel and a floodplain.

Humans, however, have modified many natural streams by increasing the capacity of the stream channel to carry high flows - sometimes as high as from a 50 or 100-year storm. These modifications are often undertaken in the name of flood control and are used to justify the human use and development of floodplains.

While most engineered channel modification designs give a great

The Effects of Siltation in Rivers and Streams



Siltation is one of the leading pollution problems in the Nation's rivers and streams. Over the long term, unchecked siltation can alter habitat with profound effects on aquatic life. In the short term, silt can kill fish directly, destroy spawning beds and increase water turbidity resulting in depressed photosynthetic rates.

Press & Siever

deal of attention to the conveyance of floodwater, they often neglect to consider sediment conveyance.

Unfortunately, stream channels that are designed to carry larger storm events naturally alter sediment transport processes. A stream channel that has been straightened and enlarged to carry a 50-year storm, for example, will begin to form a smaller channel, point bars, floodplains and meanders as the natural physical behavior of the sediment to settle out occurs.

Streams that have been channelized can become unstable as they lose their shape and slope through erosion. Unstable channel conditions ultimately lead to degraded water quality because of excessive sediment loading.

HOW DOES SEDIMENT AFFECT WATER QUALITY?

The impact of sediment on fish populations depends on both the concentration and degree of sediment, but impact severity can also be affected by the duration (or dose) of sedimentation. For example, suspended sediments may be present at high concentrations for short periods of time, or at low concentrations for extended periods of time. The greatest impacts to fish populations occur when sediment is present in high concentrations for extended periods.

Suspended sediments can clog the gills of fish, reducing their respiratory abilities. Fish stressed by respiratory difficulties may, in turn, have a reduced tolerance level to



disease, toxicants and chronic turbid conditions (Waters, 1995).

The amount of sedimentation in surface water affects the habitat of aquatic macroinvertebrates as well as the quality and amount of fish spawning and rearing habitat. These effects can be seen in alterations to community density, diversity and structure (Lenat et al., 1979). The degree of sedimentation can be estimated by observing the amount of streambed covered, the depth of sedimentation and the percent of embeddedness.

REDUCING WATER QUALITY IMPACTS FROM SEDIMENT

Sedimentation is a widespread NPS water quality problem that results primarily from land-disturbing activities; the most significant of which are agriculture and land development (e.g., highways, shopping centers and residential subdivisions). Federal, state and local government agencies have implemented various programs designed to minimize soil loss from each major type of land-disturbing activity.

Although North Carolina does not have a numeric water quality standard for suspended sediment, point source dischargers must meet minimum federal effluent guidelines of 30 mg/l for total suspended solids (TSS). In addition, a TSS limit of 10 mg/l applies to discharges to High Ouality Waters (HOW) that are trout waters or primary nursery areas, and a 20 mg/l limit applies to discharges to other HQWs. Biochemical oxygen demand (BOD) limits in place for most types of point source dischargers, however, usually dictate a degree of treatment that assures the removal of solids below federal requirements.

While North Carolina does not have standards for suspended sediment, it

does use numerical instream turbidity standards to measure water clarity:

- 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters
- 25 NTU in lakes and reservoirs not designated as trout waters
- 10 NTU in trout waters

Land-disturbing activities that implement approved best management practices are considered to be in compliance with these standards.

STREAMBANK EROSION AND LOSS OF RIPARIAN VEGETATION

Streambank erosion can be caused by a number of factors, some of which may be difficult to identify. For example, erosion may be caused by a lack of bank vegetation that holds soil in place. Erosion may also result from complex changes in urban runoff patterns, poor logging or farming practices or other activities within the watershed.

Because the stabilization of a streambank can be an expensive and time-consuming process that may

Sediment Control-Related Programs

Agriculture

- NC Agriculture Cost Share Program
- North Carolina
 Cooperative Extension
 Service and Agricultural
 Research Service
- Watershed Protection and Flood Prevention Program (PL 83-566)
- Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA)

Construction and Urban Development

- Sediment Pollution Control Act
- Federal Urban Stormwater Discharge Program
- Water Supply Protection Program
- ORW and HQW Stream Classification

Forestry

- Forest Practice Guidelines
- National Forest Management Act
- Forest Stewardship Program
- Forestry Best
 Management Practices
- Forest Management Program Services

Mining

• The Mining Act of 1971

Wetlands Alterations

- Section 10 of the Rivers and Harbors Act of 1899
- Section 404 of the Clean Water Act
- Section 401 of the Water Quality Certification (from CWA)
- North Carolina Dredge and Fill Act (1969)



require several attempts, the specific cause and nature of a problem should be investigated and understood before any action is taken to restore a degraded stream channel or riparian area.

The following techniques can help control sediment loading and protect instream water quality:

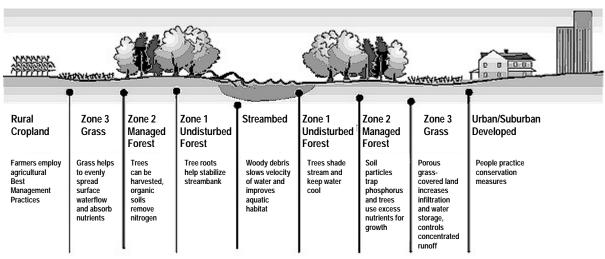
- Avoid the disturbance of streams and riparian zones
- Protect existing riparian forest buffers and restore vegetation that has been cleared from the riparian zone.
- Use BMPs for sediment control: a variety of agricultural BMPs effectively controls sediment including conservation tillage/residue management, filter strips, field borders and cover crops.
- Maintain natural channels, or if modification is unavoidable, design channels based on the stability and

- behavior of natural stream channels. Channel designs based on natural stability principles will be less susceptible to erosion, remain more stable and provide more habitat than traditional engineered channel designs.
- Maintain predevelopment peak flows, flow velocities and flow timing to the extent possible using stormwater management techniques and appropriate BMPs.
- Use BMPs such as riser basins, diversion ditches, rock dams, check dams and buffers for construction activities.

↑ USING RIPARIAN BUFFERS TO PROTECT STREAM QUALITY AND INTEGRITY

A stream and its riparian area function as one. The condition of a riparian area plays a pivotal role in the integrity of a stream channel and instream water quality. While any type of streamside vegetation is

The width of a riparian buffer is site specific and dependent on the landowner's objectives. The three-zone buffer concept provides a framework for the establishment and maintenance of a long-term riparian buffer.



Riparian Buffer Management: Riparian Forest Buffer Design, Establishment and Maintenance: Maryland Cooperative Extension



desirable, forests provide the greatest amount of benefit and the highest potential for meeting both water quality and habitat restoration objectives. Riparian forest buffers are managed to protect water quality through the control of nonpoint source pollution and the maintenance of the stream environment.

Riparian forest buffer systems are typically comprised of an area of trees, usually accompanied by shrubs and other vegetation, adjacent to a waterbody and managed as three integrated streamside zones that are designed to intercept surface runoff and subsurface flow.

A sound scientific foundation exists to support the sediment reduction, nutrient reduction and ecological values and functions of riparian forest buffers. The use of riparian buffers as a management tool should be promoted.

♣ STREAMBANK FENCING AND ALTERNATIVE LIVESTOCK WATER SUPPLY

Streambanks that are trampled by livestock can be a significant source of sediment. Streambank fencing and the location of livestock watering facilities outside the riparian zone can help maintain the vegetation needed to stabilize streambanks and prevent erosion. The water quality benefits of streambank fencing, in particular, have been well documented.

Fencing and exclusion both can create vegetative buffer strips along streams that help trap sediment and reduce the amount of pesticides and nutrients that enter the stream.

Streambank fencing also provides food, cover and nesting sites for upland and aquatic wildlife. Allowing natural vegetation to reestablish itself not only provides a higher quality habitat within the stream; it also creates a wildlife corridor that facilitates a connection with, and movement to, other habitat types.

Excluding animals from the riparian zone may also improve overall livestock health because bacteria and other disease-causing organisms in streams have been shown to transmit diseases such as environmental mastitis between, and within, livestock herds. Streambank fencing reduces animal contact with disease-causing organisms that thrive in these environments.

Streambank fencing may also improve water quality by preventing instream manure deposition (a Penn State University study showed that one cow produces approximately 5.4 billion fecal coliform bacteria per day) and reduce the risk of foot and leg injuries as part of an effective lameness prevention program.

CONSTRUCTION ACTIVITIES AND SEDIMENTATION

Because construction activities can dramatically increase sediment delivery to streams, construction activities are regulated under the North Carolina Sedimentation Pollution Control Act of 1973 which is administered by the NC Division of Land Resources (DLR). The act requires any activity that disturbs one or more acres of land to have an

Riparian forest buffers are specifically designed and managed to:

- Maintain the integrity of stream channels and shorelines by protecting them from erosion
- Reduce the impact of upland sources of pollution by trapping, filtering and converting sediments, nutrients and other chemicals
- Provide wildlife habitat for birds and other species dependant on the streams and woods for food, shelter, and raising young
- Provide shade to stabilize water temperatures, keeping water livable for fish and other aquatic species
- Provide woody debris and organic matter to the bacteria, fungi, and other species forming the basis of the aquatic food chain



1999 Erosion and Sedimentation Control Program Changes:

- Allows state and local erosion and sediment control programs to require a pre-construction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.
- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

approved Sedimentation and Erosion Control Plan in place.

The Sedimentation and Erosion Control Plan contains erosion control measures, such as barriers, filters or sediment traps, that will be used to retain sediment on a development site.

Controlling sediment that results from construction activities is the responsibility of many stakeholder groups including homeowners, developers/contractors, local governments and the NC Division of Land Resources.

Unfortunately, DLR's planning and inspection staffs must oversee a wide variety of projects that stretch across a large geographic area which means that careful pre-construction planning - perhaps the most important part of erosion control - may be overlooked due to a lack of staff time and resources. The Act, however, does allow local governments to take responsibility for reviewing and enforcing the Sedimentation and Erosion Control Act within their jurisdiction, as long as they are as stringent as DLR.

* NEW RULES REGARDING SEDIMENT CONTROL

DLR has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. While DLR has been understaffed for the past several years, the NC General Assembly provided funding for 10 new positions in the Land Quality Section of DLR in its 1999-2001 biennial budget.

In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. Also during the 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sedimentation Pollution Control Act of 1973 (SPCA).

PRIVATE ACCESS ROAD CONSTRUCTION

Improperly designed, constructed and maintained private access roads are a significant source of sediment because landowners often do not realize the importance of building driveways for long-term service.

While some landowners rely entirely on a contractor to design a private road, others will attempt to design the road themselves without ever consulting a reputable, knowledgeable source. The consequences of an improperly designed and constructed private access road may be significant and can include the loss of the road as well as adjacent property. Water quality problems can also arise, especially if a road is washed-out.

While the responsibility for designing, building and maintaining a private access road rests with the landowner, local governments, citizens and state/federal agencies can all help overcome many of the problems associated with private access roads.



FOR MORE INFORMATION...

↑ NC SEDIMENTATION CONTROL PROGRAM

For information on North Carolina's Erosion and Sedimentation Control Program, or to report erosion and sedimentation problems, visit the DLR website at http://www.dlr.enr.state.nc.us/

The following resources can be obtained from the NC Division of Land Resources (919-733-4574) at 1612 Mail Service Center, Raleigh, NC 27699-1612:

- NC Erosion and Sediment Control "Planning and Design Manual" (\$65 for in-state, \$75 for out-of-state)
- NC Erosion and Sediment Control "Inspector's Guide" (\$20 for in-state or outof-state)
- NC Erosion and Sediment Control "Field Manual" (\$20 for in-state or out-of-state)
- NC Erosion and Sediment Control "Video Modules" (\$15 for in-state, \$50 for out-ofstate)
- Erosion Patrol 3rd Grade Curriculum Supplement
- Muddy Water...It's More Dangerous Than You Think Video

∧ NCDOT SOIL & WATER ENGINEERING SECTION

Information on the North Carolina Department of Transportation's erosion & sediment control and stream restoration programs are located at:

http://www.doh.dot.state.nc.us/
operations/dpchiefeng/roadside/

Additional information can be obtained by contacting the NCDOT Soil & Water Engineering Section, Roadside Environmental Unit at:

PO Box 25201 1 South Wilmington Street Raleigh NC 27611-5201 Transportation Building - 5th Floor (919) 733-2920 FAX: (919) 733-9810 Courier: 51-31-00

Guidelines for Drainage Studies, NCDOT Hydraulic Design Unit, 1995. To obtain a copy, contact NCDOT at (919) 250-4128. Contact the NC Division of Land Resources (919) 733-3833 for a Regional Office contact name and number.



Section B-1 Sediment 18

B-2 FECAL COLIFORM BACTERIA



Fecal coliform bacteria live in the digestive tract of warm-blooded animals. They are excreted in the solid waste of humans and other mammals. In themselves, fecal coliform do not pose a danger to people or animals. Where fecal coliform are present, however, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, bacterial levels measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Management measures that address these land use characteristics, and that help decrease fecal coliform levels in surface waters, are discussed later in this section.

HOW DOES FECAL COLIFORM BACTERIA AFFECT WATER QUALITY?

The presence of fecal coliform tends to affect humans more so than aquatic creatures. High levels of fecal coliform bacteria can indicate unacceptably high levels of sewage or animal wastes which would make water unsafe for drinking, human contact (swimming) or the harvesting and consumption of shellfish.

Bacteria associated with fecal coliform, for example, can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some bacteria can also cause infection in open wounds.

Reducing fecal coliform in wastewater requires the use of chlorine and other disinfectant chemicals. Although these materials may kill the fecal coliform and disease bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, thereby endangering the survival of species dependent on those bacteria.

Untreated fecal material, such as fecal coliform, can add excess organic material to surface waters. The decay of this material can deplete the water of oxygen, causing fish and other aquatic life to die.

STANDARDS APPLIED TO PROTECT PUBLIC HEALTH

Water quality standards for fecal coliform ensure safe use of waters for water supplies, recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200).

The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on at least five consecutive samples taken during a 30-day period, not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. The 200 colonies/100ml

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals & domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater
- Runoff from developed areas



standard is intended to ensure that waters are safe enough for water contact through recreation.

The standard for SA waters (waters used for shellfishing) is a median or geometric mean fecal coliform Most Probable Number (MPN) not greater than 14 MPN/100ml. In addition, not more than 10 percent of the samples can be in excess of 43 MPN/100ml.

Many areas closed to shellfish harvesting have median levels below 14 MPN/100ml but fail to meet the second criteria due to periodic contamination that occurs after moderate to heavy rainfall events.

Although coliform standards have been used to indicate the microbiological quality of drinking water, swimming waters and shellfish harvesting waters for more than 50 years, it is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

While the detection and identification of specific bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are possible; it would require large sample volumes and sophisticated laboratory techniques that are not commonly available.

№ FECAL COLIFORM AND SHELLFISH HARVESTING

The North Carolina Division of Environmental Health has subdivided all of the state's coastal waters into shellfish growing areas in which a sanitary survey is conducted every three years. A sanitary survey is comprised of a shoreline survey, a hydrographic survey and a bacteriological survey. The shoreline survey identifies potential pollution sources. The hydrographic survey evaluates meteorological and hydrographic features of the area that may affect the distribution of pollutants. The bacteriological survey assesses water quality using fecal coliform sampling. Based on the results of the survey, waters are classified by DEH into one of the following 5 categories:

- Approved Area an area determined suitable for the harvesting of shellfish for direct market purposes.
- 2. Conditionally Approved-Open waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- Conditionally Approved-Closed waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- Restricted Area an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- Prohibited Area an area unsuitable for the harvesting of shellfish for direct market purposes.

Beginning in the summer of 1997, state public health officials began testing coastal recreation waters to ensure that they are safe for swimming. The Shellfish Sanitation Section of the Division of Environmental Health tests 275 sites weekly during the swimming season (June 1 through Labor Day) and less often during the rest of the year.

Land use characteristics that contribute to the export of fecal coliform bacteria to surface waters include:

- Land disturbance: area of disturbance, length of time of disturbance and proximity to surface waters
- Type of land use: urban, agriculture, septic tanks or forested
- Runoff volume and rate: impervious surface, width and type of vegetated areas and best management practices



These tests provide researchers and the public with a gauge of water quality along the North Carolina coast over the short and long-term.

If a certain area along the coast is found to have a water quality problem, health officials will post signs recommending that people not swim there. The location will be listed on the Shellfish Sanitation Section's web site
(http://www.deh.enr.state.nc.us/
shellfish/) and local media and
county health departments will be
notified. In addition, advisory signs
with the following language, "These
waters may be contaminated with
human or animal waste. Swimming
is not advised in these waters
because of the increased risk of
illness" are posted at wastewater
treatment plant outfalls.

REDUCING WATER QUALITY IMPACTS FROM FECAL COLIFORM BACTERIA

General management strategies for addressing fecal coliform contamination of surface and groundwater include:

- Proper maintenance and pumping of septic tanks every three to five years
- Maintenance and repair of sanitary sewer lines by WWTP authorities
- Elimination of piped unpermitted discharges of home waste (also known as "straight piping")
- Proper management of livestock to keep wastes from reaching surface waters
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation such as swimming and tubing

MANAGING FECAL COLIFORM BACTERIA IN SHELLFISH WATERS

The management of coastal water quality in order to maintain acceptable fecal coliform concentrations for the safe consumption of shellfish is complex. One of the most important issues in setting management priorities is the quality of the shellfish resource in a particular area.

It should be noted that the restoration of water quality in all closed shellfish waters may not be an attainable objective, particularly in the short run, because some contamination may be due to natural conditions (e.g., poor hydrologic flushing, fecal coliform inputs from wildlife) or inputs from developed areas that cannot be effectively or economically mitigated.

↑ **DEVELOPMENT THRESHOLDS**

It would be useful to identify a development threshold beyond which contamination of shellfish waters is likely to occur. Such a threshold would be extremely difficult to establish because of the variety of factors that must be considered including the amount of development, type, the specific practices used and the nature of the land prior to development.

Research shows that stream water quality degradation often becomes significant once impervious cover in a watershed exceeds 10-15%

Most shellfish water closures in developed areas result from a combination of factors including:

- Development approved prior to January 1, 1988 (and not subject to the current stormwater regulations) that has built out over the past few years
- Density levels that have been allowed without stormwater BMPs
- Required buffers for low and high density development projects that may be too small
- Cumulative impacts of numerous small projects not subject to stormwater regulations
- A lack of vegetative buffers or the inability of developers to adhere to a stringent revegetation schedule
- Animal populations (both wildlife and livestock), timber harvesting and associated land disturbance and crop preparation



(Schueler, 1994). These studies have been conducted primarily on freshwater streams, and no systematic effort has yet been undertaken to establish a relationship between shellfish closures and the extent of impervious surface (Schueler, 1994).

Other research (Tschetter and Maiolo, 1984) has shown a correlation between coastal population growth in North Carolina and the closure of waters to shellfishing. Unfortunately, this work is too general to be useful for management purposes.

Another study of coastal watersheds in New Hanover County (Duda and Cromartie, 1982) found that closings generally occurred in areas that had more than one septic system drainfield per every seven acres of watershed. It is unclear how subsurface drainage networks may have contributed to the study, or how widely the results of this investigation can be applied.

What these efforts do show is that there is a strong empirical relationship between land development and shellfish water closures that should not be ignored if shellfish waters are to be adequately protected or restored.

↑ CONSTRUCTION, STORMWATER AND LAND USE ISSUES

There are many aspects of development that can influence fecal coliform export from urban areas. Some of the most common are the size of the disturbed area, length of nonvegetated stage, size of vegetated buffer, amount of impervious surface and the design and use of sediment or stormwater control devices.

Shellfish water closures in developed areas are more likely the result of improper maintenance or installation of best management practices, a lack of stream buffers or the ditching and piping of adjacent land areas.

Changes in DWQ's stormwater rules seek to address many of these issues, including the enhancement of long-term enforcement and the management of cumulative impacts of smaller projects.

↑ SEPTIC SYSTEM IMPACTS

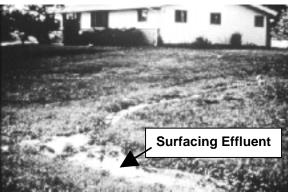
Septic systems are common throughout North Carolina. Most are located in rural areas that fall outside of a regional wastewater treatment plant's service area. Unfortunately, many citizens fail to properly care for their septic systems.

Water contamination from septic systems is another complex issue, although local governments around the country are finding innovative ways to address them. In order to protect water quality in the Chesapeake Bay, for example, Arlington County, Virginia has adopted an ordinance requiring all septic tanks to be pumped at least once every 5 years (USEPA, 1993).

Stinson Beach, California developed a management program for on-site systems after discovering that malfunctioning systems were threatening public health (Herring, 1996). Homeowners here pay a monthly fee to cover the cost of



An Example of a Failing Drainfield



North Carolina Cooperative Extension Service

inspections and testing, in addition to any construction and repair costs (USEPA, 1993).

In the Puget Sound area, where a significant shellfish resource has been threatened by fecal coliform contamination from a number of sources, most counties have established revolving loan funds to facilitate the repair of failing systems (Center for Watershed Protection, 1995).

Experience has shown that widespread community support is generally necessary to mount an effective campaign that addresses septic system contamination issues, and that this support is unlikely to be forthcoming in the absence of any significant perceived benefits (Herring, 1996).

A STATE AND LOCAL INTERACTION THROUGH CAMA

The need for additional state and local actions to protect coastal water quality was the basis for establishing the Coastal Area Management Act (CAMA) in 1974. Since the enactment of CAMA, the state's role in coastal water quality has

continued to evolve and now includes DWQ's coastal stormwater rules, DCM's rules for issuing development permits in Areas of Environmental Concern (AEC) and the continuing development of DLR's Sedimentation and Erosion Control Program. Local governments are primarily responsible for CAMA's local land use planning requirements.

Since additional limitations on shellfish harvesting have occurred since CAMA has been promulgated, it is clear that these policies have not adequately protected coastal water quality.

A GROWTH MANAGEMENT

Growth management can be defined as the application of strategies and practices that help achieve sustainable urban development and redevelopment in harmony with the conservation of environmental qualities and features. In other words, growth management is the effective and equitable management of growth and change in human habitats.

On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Although growth management doesn't stop growth - it ensures that growth occurs within a framework for the provision of affordable services - the planning process has remained relatively unpopular among local governments due to a lack of understanding (Center for Watershed Protection, 1995).

Growth Management Elements Applicable to the North Carolina Coast

- Use Watershed-Based Land Use Planning
- Treat Stormwater
- Minimize Impervious Cover in Site Design
- Protect Sensitive Natural Areas
- Limit Erosion During Construction
- Establish Buffer Network
- Maintain Coastal Growth Measures



Growth Management Tools

- Overlay Zoning
- Greenbelts
- Transfer of Development Rights
- Watershed Impervious Limits
- Marina Siting and Design
- Forest Conservation
- Septic System Siting Criteria
- Shoreline and Wetlands Buffers
- Modification of Street Standards
- Modification of Parking Areas
- Siting Clearing Standards
- Stormwater Treatment
- Cluster Zoning
- Marina Pumpout
- Septic System Alternatives
- Regional CAMA Planning
- Wastewater Authority
- Stormwater Authority
- Wastewater/ Stormwater Authority
- Waste Quality Authority
- Sensitive Habitat Protection Ordinance
- Septic System Inspection and Maintenance

Growth management tools range from on-the-ground best management practices (BMPs) such as modifying parking areas to reduce impervious surfaces, to establishing regional wastewater and/or stormwater authorities. Growth management tools can be tailored to both rural and developed areas and to inland, soundside and barrier island locations.

Increasingly, local governments in areas such as the Chesapeake Bay and Puget Sound watersheds have recognized that a more proactive approach is essential to protect their coastal resources. Seventy percent of the local governments in the Puget Sound region, for example, have adopted some form of stormwater management plan (Dohrmann, 1995).

Over the past several years, DWQ has been involved in a number of projects to encourage and assist local governments in carrying out wastewater planning and growth management activities. These include participation in the Regional Wastewater Task Force (Carteret, Craven, Onslow and Pamlico Counties), and in preparation of the Blueprint to Protect Coastal Water

Quality: A Guide to Successful Growth Management in the Coastal Region of North Carolina (Center For Watershed Protection, 1995).

Local governments should consider the application of growth management techniques outlined in the "Blueprint" document. It provides practical concepts and tools that can be implemented at the local level to protect coastal water quality. Copies are available free of charge from DWQ's Planning Branch at (919) 733-5083.

ANIMAL WASTE MANAGEMENT

North Carolina rules require any confined livestock facility with more than 100 cows, 75 horses, 250 swine, 1,000 sheep or 30,000 birds that uses a liquid waste system to have a Certified Animal Waste Management Plan. This plan outlines the best management practices that will be implemented to eliminate the discharge of waste to surface waters.

DWQ is pursuing several strategies that will improve the management of waste generated from animal production operations. Refer to Section C-3 for more information.



B-3 NUTRIENTS



Nutrients refers to the elements phosphorus and nitrogen, both of which are common components of fertilizers, animal and human wastes, vegetation, aquaculture and some industrial processes.

Nutrients in surface waters come from both point and nonpoint sources including agricultural and urban runoff, wastewater treatment plants, forestry activities and atmospheric deposition. Nutrients in nonpoint source runoff come mostly from fertilizer and animal wastes. Nutrients in point source discharges typically come from human waste, food residues, cleaning agents and industrial processes.

HOW DO NUTRIENTS AFFECT WATER QUALITY?

While nutrients are beneficial to aquatic life in small amounts, excessive nutrient concentrations can stimulate algal blooms and plant growth in ponds, lakes, reservoirs and estuaries. Through respiration and decomposition, algal blooms can deplete the water column of dissolved oxygen and contribute to serious water quality problems.

In addition, algal blooms can also be aesthetically undesirable, cause an unbalanced food web, impair recreational uses of surface waters, impede commercial fishing and pose problems for water treatment systems.

Algal growth and the depletion of dissolved oxygen caused by nutrient overenrichment fluctuate seasonally, sometimes even over the course of a single day.

In the presence of sunlight, for example, oxygen is produced by algae and other plants through the process of photosynthesis. At night, however, photosynthesis and dissolved oxygen production slow down while oxygen is consumed by algae through respiration.

Algae may also settle to the bottom of a waterbody and contribute to sediment oxygen demand as they decompose through bacterial action. This type of decomposition lowers dissolved oxygen concentrations in the bottom waters of lakes and other bodies of water.

During the summer months, the daily cycle of daytime oxygen production and nighttime depletion can result in supersaturation - a condition that occurs when dissolved oxygen levels are greater than the saturation value for a given temperature and atmospheric pressure. High dissolved gas levels can be lethal to fish populations by inhibiting respiratory processes.

Chlorophyll a, a constituent of most algae, is a widely used indicator of algal biomass. North Carolina has a chlorophyll a standard of $40 \mu g/l$ (micrograms per liter) for lakes, reservoirs and slow-moving waters not designated as trout waters and a

 $15 \mu g/l$ standard for trout waters. Total dissolved gas levels in excess of 110 percent of saturation are also a violation of standards.

In addition to algae, the excessive growth of larger plants called macrophytes can become problematic when they limit recreational opportunities in surface waters. Some examples include milfoil, alligator weed and Hydrilla.

RESERVOIR AND LAKE

Eutrophication is the natural accumulation of nutrients and sediment in lakes and reservoirs. When a surface waterbody becomes nutrient rich, biologically productive and able to support high levels of algae or macrophyte growth, it is classified as eutrophic. As a group, reservoirs tend to have higher inflows and nutrient and sediment loads than natural lakes, and are therefore more likely to be eutrophic. In North Carolina, this is especially true of piedmont reservoirs.

sequence is usually depicted as a unidirectional progression corresponding to a gradual increase in lake productivity from oligotrophy to hypereutrophy.

There is evidence, however, that changes in lake trophic status are not necessarily gradual or unidirectional.

In watersheds that remain relatively undisturbed, for example, lakes can retain the same trophic status for thousands of years. On the other hand, rapid changes in lake nutrient status and productivity are often the result of cultural eutrophication human disturbances to the watershed - rather than gradual enrichment and filling of the lake basin through natural processes.

Free-flowing streams with relatively undisturbed watersheds tend to have low nutrient levels, and an increase in nutrient inputs can affect aquatic life by supporting increased growth of benthic algae. Such changes in benthic algal growth can significantly affect fish communities. Nutrient loading to streams can cause some degradation in the water quality of free-flowing piedmont streams, but does not generally result in water quality impairment.

Eutrophic conditions can, but do not always, interfere with a waterbody's uses. Some lakes and reservoirs can support substantial algal growth without significantly affecting recreational activities or aquatic organisms.

EUTROPHICATION

The classical lake succession

REDUCING WATER QUALITY IMPACTS FROM NUTRIENTS

Reductions in nutrient loads are needed to limit algal growth potential and fish kills, and to assure the protection of instream chlorophyll a standards in the state's waterways.

Point source controls typically include NPDES permit limitations on total phosphorus (TP) and/or total nitrogen (TN). Nonpoint source controls of nutrients generally include BMPs that control nutrient



Lake Trophic

Oligotrophic

Nutrient-poor and low biological productivity. Typical of cold-water lakes.



Mesotrophic

Intermediate nutrient availability and biological productivity.



Eutrophic

Nutrient-rich and highly productive.



Hypereutrophic

Extreme productivity characterized by algal blooms or dense macrophyte populations (or both) frequently having a high level of sedimentation.



loading from agricultural land, urban areas and other sources. Appendix 2 contains a comprehensive listing of BMPs that can be implemented to reduce nonpoint source pollution inputs.

NUTRIENT SENSITIVE WATERS CLASSIFICATION

Nutrient sensitive waters (NSW) is a supplemental water classification applied to waters that are experiencing, or are subject to, excessive growths of microscopic or macroscopic vegetation. The NC Environmental Management Commission (EMC) defines excessive vegetation growth as that growth which can substantially impair the use of a waterbody for its best usage as determined by the classification applied to that waterbody.

NSW may include any or all waters within a river basin that the EMC deems is necessary to effectively control excessive growths of aquatic vegetation. For the purposes of this classification, "nutrients" refers to phosphorus and nitrogen, although other nutrients or chemicals may be specified if it is determined that they are essential to the growth of aquatic vegetation.

No increase in nutrients over background levels is allowed within NSW waters unless it can be shown that: 1) the increase is the result of natural variations; 2) the increase will not endanger human health, safety or welfare; and 3) preventing the increase would cause a serious economic hardship without equal or greater public benefits.

◆ TAR-PAMLICO NUTRIENT SENSITIVE WATERS STRATEGY

In the late 1980's, increases in algal blooms and fish kills in the upper Pamlico estuary were linked to excessive nutrient levels in the River. These conditions led the Environmental Management Commission to designate the entire Tar-Pamlico River basin as Nutrient Sensitive Waters (NSW) in 1989. This designation required the state to develop a nutrient management strategy for the basin.

Phase I of the strategy, which ran from 1990 through 1994, initially targeted point sources of pollution before addressing nonpoint pollution sources. Phase I involved an innovative trading program that offered cost-effective nutrient reduction options for point source dischargers.

Phase II of the program, which runs through 2004, used an estuarine model to establish an interim nitrogen reduction goal of 30% of 1991 levels. Phase II also includes a separate nonpoint source strategy that initially began as a voluntary program in 1996. In 1998, the EMC determined that NPS rules were needed in the basin. Seven professionally facilitated stakeholder teams were formed to evaluate all aspects of the rule making process.

The EMC adopted temporary buffer rules in December 1999 and urban stormwater and nutrient management rules in July 2000. Buffer rules became permanent in August 2000. Stormwater and nutrient management rules are to become

Waters classified by the Commission as NSW include:

- The Neuse River Basin
- The Tar-Pamlico River Basin
- The Chowan River Basin
- The New River watershed within the White Oak Basin
- The watershed of Jordan Reservoir within the Cape Fear River Basin



Neuse NSW rules:

- Place nitrogen limits on individual point source discharges below Falls Lake dam.
- Require the basin's most heavily populated and fastest growing local governments to take responsibility for managing their stormwater.
- Require that 50-foot riparian areas be protected and maintained on both sides of streams, rivers, lakes and estuaries.
- Require farmers to either become part of a collective local strategy for implementing BMPs or implement standard BMPs.
- Require some individuals that apply nutrients to either complete nutrient management training or develop nutrient management plans.

permanent in April 2001. A separate rule on agriculture, which will be adopted in October 2000, is scheduled to become effective August 2002.

NEUSE RIVER NUTRIENT SENSITIVE WATERS MANAGEMENT STRATEGY

A draft nutrient management strategy for the Neuse River was approved by the EMC in 1996. The final strategy was approved in December 1997 with most rules becoming effective in August 1998.

The strategy is aimed at reducing the average annual load of nitrogen delivered to the Neuse River Estuary from point and nonpoint pollution sources. The goal is to reduce, by 2004, the average annual load delivered between 1991 and 1995, by a minimum of 30 percent.

PHOSPHATE DETERGENT BAN

On January 1, 1988, the NC General Assembly limited the amount of phosphate in household laundry detergents to 0.5 percent. A statewide study of 23 municipal wastewater plants found that this phosphate detergent "ban" significantly reduced the amount of phosphorus entering wastewater treatment plants, which resulted in a 33% average reduction in the mass phosphorus load discharged from these facilities (NCDEM, 1991).

To determine if a reduction in effluent phosphorus led to a substantial decline in instream phosphorus levels in a particular waterbody, the relative contribution of point and nonpoint source phosphorus loading in that waterbody had to be determined. An analysis of several NC sites found reductions in ambient phosphorus levels downstream of major WWTPs (NCDEM, 1991).

B-4 OXYGEN-CONSUMING WASTES



Maintaining adequate dissolved oxygen (DO) concentrations are critical to the survival of aquatic life and to the general health of North Carolina's surface waters.

Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce dissolved oxygen levels in surface water through chemical reactions or biological activity. Sources of dissolved oxygen- consuming wastes include wastewater treatment plant effluent, aquaculture waste, the decomposition of organic matter (such as leaves, dead plants and animals) and organic waste matter that is deposited, washed or discharged into surface water.

Bacterial decomposition of these organic waste streams can rapidly deplete dissolved oxygen levels, especially if they are not adequately treated at a wastewater treatment plant prior to being discharged into the environment.

The daily average dissolved oxygen standard for most waters in the state, except for those classified as trout or swamp waters, is 5.0 mg/l. Trout waters have a daily average DO standard of 6.0 mg/l.

Biochemical oxygen demand (BOD) and ammonia nitrogen (NH₃-N) associated with wastewater treatment plants are generally the two oxygenconsuming wastes of greatest concern. During summertime conditions, when water temperatures

are high and streamflow is low, point sources of BOD and NH₃-N have the greatest impact on instream dissolved oxygen concentrations.

Some chemicals also react and bind with dissolved oxygen. Industrial discharges with oxygen-consuming wasteflows, for example, may be extremely resilient and continue to use oxygen for a long distance downstream.

Nonpoint source inputs, which typically occur as a result of rainfall events, are generally a minor source of oxygen-consuming waste.

HOW DO OXYGEN-CONSUMING WASTES AFFECT WATER QUALITY?

The primary water quality impact of oxygen-consuming wastes is similar to that of low dissolved oxygen levels because oxygen-consuming wastes use up (or consume) oxygen that is needed to maintain aquatic life. As oxygen is used up, levels can fall below that which is necessary to sustain life, resulting in the death of fish and other organisms that live in the water. Low dissolved oxygen levels can also affect the reproduction and growth functions of fish (Alabaster and Lloyd, 1982).

FACTORS AFFECTING DISSOLVED OXYGEN

A number of factors influence dissolved oxygen concentrations in surface waters. For example, high dissolved oxygen is produced by



turbulent actions, such as waves, rapids and waterfalls that mix air into the water. Lower water temperatures also generally allow for the retention of higher dissolved oxygen concentrations. The cool, swift-flowing streams of the mountains are generally high in dissolved oxygen.

Lower dissolved oxygen levels tend to be more common in warm, slow-moving waters. In some cases, dissolved oxygen levels may naturally decrease below the state standard in the warmer summer months. In addition, high inputs of effluent from wastewater treatment plants during low flow conditions can also decrease dissolved oxygen levels. In general, the lowest dissolved oxygen concentrations occur in the summer during low flow periods.

Water depth is also a factor. In deep, slow-moving waters such as reservoirs or estuaries, dissolved oxygen concentrations may be very high near the surface - due to wind action and plant (algae) photosynthesis - but decline to zero (anoxic) at the bottom.

In 1993, the United States Geological Survey (USGS) developed a report entitled Low Flow Characteristics of Streams in North Carolina. The USGS defined ten low flow hydrologic areas (HA1-HA10) in North Carolina by relating topography, geology, mean annual runoff and other features to low flow frequency characteristics including 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded in 9 out of 10 years) and 30Q2 (annual minimum 30-day consecutive low flow, which on average, will be exceeded in 1 out of 2 years). The ten HAs form a general southwest-northeast band across the state and lie within three physiographic areas: 1) the Coastal Plain, 2) the eastern and central Piedmont and 3) the western Piedmont and mountains.

In general, the lowest potential for sustaining base flow to streams is in the clay and sandy soils area of the Coastal Plain (HA1 and HA2) physiographic area and in the eastern and central Piedmont (HA4, HA6, HA7 and HA8) physiographic area.

REDUCING WATER QUALITY IMPACTS FROM OXYGEN-CONSUMING WASTES

MODELING

Computer models are used by DWQ to determine oxygen-consuming waste (BOD) limits in NPDES permits. The model used, either North Carolina's desktop empirical model (Level B) or the field-calibrated QUAL2E model, is determined by the amount of data

available for a given reach of stream. Modeling is not conducted in some cases - such as for discharges to swamp-like systems, zero flow streams and HQW stream segments - where NPDES permit limitations are determined by special procedures or regulations.



NPDES PERMIT LIMITS

NPDES permits for wastewater discharges generally limit BOD₅ (or CBOD₅) and NH₃-N in order to control the effects that oxygen depletion can have in receiving waters. Where residual BOD is significant, management of nonpoint sources to reduce loading is recommended through the implementation of best management practices.

DISCHARGES TO ZERO AND LOW FLOW STREAMS

Due to the preponderance of low flow streams across the state, DWQ has developed regulations for evaluating discharges to such waters. In 1980, a study was performed on zero flow streams (7Q10 = 0 cfs and 30Q2 = 0 cfs) to determine the effects of wastewater discharges.

As a result of the study, regulations [15A NCAC 2B .0206 (d)] were developed that prohibit new or expanded discharges of oxygenconsuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge, and some built new treatment plants to meet advanced tertiary limits for BOD₅ and NH₃-N.

This policy typically covers small discharges such as schools, mobile home parks, subdivisions and rest homes which discharge to zero flow streams in headwater areas. Such discharges generally do not cause significant water quality problems in the mainstem of larger tributaries, but they can cause localized problems in zero flow receiving streams.

DISCHARGES TO SWAMP WATERS

As a means of better addressing concerns over discharges to swamp waters, DWQ conducted a field study in the Lumber River basin in 1996.

The study was initiated to address the difficulties associated with modeling swamps, and to make effective predictions regarding the impact of discharges on swamp waters. The main purpose of the study was to evaluate and compare the potential impacts of discharges with advanced tertiary treatment (i.e., BOD₅ levels of 5-7 mg/l or less) and advanced secondary treatment (i.e., BOD₅ levels of 10-20 mg/l) on instream dissolved oxygen (DO) levels.

The study pointed out that swamp waters are dynamic and complex systems that can not be generalized.





B-5 TOXIC SUBSTANCES

Regulation 15A NCAC 2B. 0202(36) defines a toxic substance as "any substance or combination of substances ... which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions or suppression in reproduction or growth) or physical deformities in such organisms or their offspring or other adverse health effects."

Toxic substances frequently encountered in water quality management include chlorine, ammonia, organics (hydrocarbons and pesticides), heavy metals and pH. Because these substances are toxic to different organisms at different levels, their effects can be immediately evident, or may manifest only after long-term exposure or accumulation in living tissue.

pН

pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). As the pH of a waterbody decreases (water becomes more acidic), some metals within it may become more soluble and more toxic to aquatic organisms. If a surface waterbody has had chronic

introductions of metals, and the pH gradually or dramatically decreases (becomes more acidic), the metals may become more soluble and readily available in the water column.

| Hydrochloric Acid (HCI) | 0.0 | ě |
|-------------------------|-------|-------------|
| Gastric Juices | 1.0 | I ë |
| Lemon Juice | 2.3 | |
| Vinegar | 2.9 | |
| Wine | 3.5 | |
| Tomato Juice | 4.1 | |
| Coffee (black) | 5.0 📆 | |
| Acid Rain | 5.6 🎇 | |
| Unine | 6.0 | 圖漢 |
| Rainwater | 6.5 | |
| Milk | 6.6 | |
| Pure Water | 7.0 | |
| Blood | 7.4 | |
| Baking Soda Solution | 8.4 🎆 | |
| Borax Solution | 9.2 | |
| Toothpaste | 9.9 | |
| Milk of Magnesia | 10.5 | |
| Limewater | 11.0 | |
| Household Ammonia | 11.9 | 2 |
| Sodium Hydroxide (NaOH) | 14.0 | ii 2 |

US EPA

As the pH increases, however, metals may be precipitated out of the water column and become less available as toxicants to aquatic organisms. While lower pH values may not be toxic to aquatic organisms, lower values can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton.

Macroinvertebrates, for example, may show a shift from intolerant species to tolerant species with less community diversity.

Changes in the pH of surface waters occur primarily through point source discharges. Changes can also occur through spills, acid deposition and algal blooms.



METALS

Some metals can have a negative impact upon both human and aquatic life. Some organo-metals can build up in the fatty tissue of fish by uptake through the food chain, making them potentially unsafe for human consumption. Metals in surface waters can also have chronic, sublethal effects such as neurological and respiratory effects on aquatic organisms.

A variety of water quality characteristics including dissolved and particulate organic carbon, pH and hardness affect the availability of metals and their subsequent impacts upon aquatic life (Bergman and Dorward-King, 1997). North Carolina has adopted water quality standards to protect aquatic life and human health.

Metals enter surface waters through industrial and wastewater point source dischargers and atmospheric deposition.

CHLORINE

Chlorine is a greenish-yellow gas that dissolves easily in water. Because chlorine is an excellent disinfectant, it is commonly added to most drinking water supplies in the US. Chlorine is also used as a disinfectant in wastewater treatment plants and swimming pools, and as a bleaching agent in textile factories and paper mills. Chlorine is an important ingredient in many laundry bleaches.

Free chlorine (chlorine gas dissolved in water) is toxic to fish and aquatic organisms, even in very small amounts. Chlorine becomes more toxic as the pH level of the water drops, or when it is combined with other toxic substances such as cyanides, phenols or ammonia. The effects of chlorine are relatively short-lived compared to most other highly poisonous substances. This is because chlorine reacts quickly with other substances in water (and forms combined chlorine) or dissipates as a gas into the atmosphere.

If water contains a lot of decaying materials, free chlorine can combine with them to form compounds called trihalomethanes or THMs. Some THMs in high concentrations are carcinogenic to people. Unlike free chlorine, THMs are persistent and can pose a health threat to living things for a long time.

AMMONIA (NH₃)

Pure ammonia is manufactured from nitrogen and hydrogen or is produced from coal gas. In nature, ammonia is formed by the action of bacteria on proteins and urea. Because ammonia makes a powerful cleaning agent when mixed with water, it is one of the most common industrial and household chemicals.

Because ammonia is rich in nitrogen, it also makes an excellent fertilizer. In fact, ammonium salts are a major source of nitrogen for fertilizers, which can speed the process of eutrophication in waterways.

Ammonia is toxic to fish and aquatic organisms even in very low concentrations. When levels reach 0.06 mg/l, fish can suffer gill



damage. When levels reach 0.2 mg/l, sensitive fish like trout begin to die. As levels near 2.0 mg/l, even ammonia-tolerant fish like carp begin to die. Ammonia levels greater than approximately 0.1 mg/l usually indicate polluted waters.

The danger ammonia poses for fish is dependent upon on water temperature and pH, along with dissolved oxygen and carbon dioxide levels. Ammonia is also more toxic

to fish and aquatic life when the water column contains very little dissolved oxygen and carbon dioxide.

Point source dischargers are the primary sources of ammonia. In addition, decaying organisms from nonpoint source runoff and bacterial decomposition of animal waste products contribute to increased ammonia levels in surface water.

REDUCING WATER QUALITY IMPACTS FROM TOXIC SUBSTANCES

pН

The NC standard for pH in surface freshwaters is 6.0 to 9.0. Trout reproduction is adversely affected in waters with pH values below 5.5.

In general, DWQ applies limits to NPDES permit holders requiring effluent to be within a pH range of 6.0-9.0.

METALS

North Carolina has adopted standards for several toxic substances including cadmium, chromium, copper, nickel, lead, mercury, silver and zinc. For some, the standards are in the form of action level standards. Limits are not usually assigned for parameters that have action level standards unless 1) monitoring indicates that the parameter may be causing toxicity or 2) federal guidelines exist for a given discharger for an action level substance. North Carolina has stream standards and action level standards for many heavy metals.

The process of determining action level standards exists because some toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life due to chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality-based limits may also be assigned to a given NPDES permit if data indicates the presence of a substance for which there is a federal criterion, but no water quality standard.

CHLORINE

North Carolina has adopted a freshwater standard for trout waters of $17 \mu g/l$ (micrograms per liter) for total residual chlorine. For all other waters, an action level of $17 \mu g/l$ for total residual chlorine is applied to protect against toxicity. A total residual chlorine limit is assigned based on the freshwater action level standard of $17 \mu g/l$ or a maximum concentration of $28 \mu g/l$ for protection against acute effects in the mixing zone. Federal guidelines for residual chlorine of $8 \mu g/l$ for



chronic effects and 13 μ g/l for acute effects are used in saltwaters. It is recommended that new and expanding discharges provide dechlorination or alternate wastewater disinfection.

AMMONIA

DWQ addresses ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). Current limits are no less than 2 mg/l in summer and 4 mg/l in winter, unless dissolved oxygen problems or modeling analysis dictate stricter limits. These interim criteria are under review, and the state may adopt a standard in the future.

WHOLE EFFLUENT TOXICITY TESTING AT NPDES FACILITIES

Whole effluent toxicity (WET) testing is required on a quarterly basis for major NPDES dischargers (>1 MGD) and any discharge containing complex (industrial) wastewater. A WET test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity.

If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a toxicity reduction evaluation (TRE). Other testing, or monitoring, done to detect aquatic toxicity problems include fish tissue analyses, chemical water quality sampling and assessment of fish community and bottom-dwelling

organisms such as aquatic insect larvae.

Over 21,000 compliance WET tests have been performed since July 1995. Over 90% of the facilities with acute and chronic limits have been in compliance with those limits.

NPDES PERMIT LIMITS

Point source discharges of metals are controlled through the NPDES permit process. Municipal treatment facilities that accept discharges from industrial users limit the heavy metals they receive through a pretreatment program. Source reduction and wastewater recycling at WWTPs also help to reduce the amount of metals that is released into the environment.

Permit limits for specific toxicants are based on the volume of the discharge and the flow conditions of the receiving waters. These methods utilize an EPA recommended approach that considers the maximum predicted effluent concentration and the amount of variation in effluent monitoring data. Whole effluent toxicity limits are assigned to all major dischargers and to dischargers of complex wastewater.

In 1993, letters were sent to facilities that had chlorine monitoring requirements encouraging permittees to examine their effluent chlorine levels, noting that limits may be implemented in the future. At this time, the state requires chlorine limits for all trout waters and any new or expanding facilities using chlorine for disinfection.



NONPOINT SOURCE CONTROLS

Nonpoint source strategies being implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic

substance loading to surface waters. Agricultural BMPs implemented to reduce nutrient and sediment loading from cropland are also likely to result in lower pesticide inputs.



B-6 COLOR

Color is generally associated with industrial wastewater, municipal plants that receive industrial wastes from textile manufacturers that dye fabrics and pulp and paper mills.

HOW DOES COLOR AFFECT WATER QUALITY?

Color can affect the aesthetic quality of a waterbody and interfere with sunlight penetration. Water plants need light for photosynthesis. If color blocks out light, photosynthesis - and the production of oxygen for fish and aquatic life - will be

reduced. If light levels get too low, photosynthesis may stop altogether, causing algae to die.

In addition, fish may not be able to see very well in waters polluted with color and may have difficulty finding food.

Color is usually not a toxicological problem, and there is no current data showing that colored effluent poses any human health threat, or that it is the sole source of aquatic life impacts in the river.



According to state regulations, colored effluent is allowed in "only such amounts as will not render the waters injurious to public health, secondary recreation, or to aquatic life and the wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses."

The state has considered developing a numeric standard for color, but there are many challenges in doing so. Some of these challenges include knowing what the appropriate analytical approach is; what the appropriate numeric standard is; and if a different standard should be used for different regions in the state to reflect variations in background water color.

The practical application of this regulation must also take into

account the various ways in which color is perceived. No narrative definition of color impairment can be specified by a simple set of criteria because color is perceived differently under varying conditions.

The advantage of a narrative standard is that it is flexible. The disadvantages are that it is subjective and difficult to enforce.

DWQ COLOR REDUCTION STRATEGY

All dischargers with colored waste are required to conduct toxicity testing on the effluent to assure that the discharge will not adversely impact the organisms in the receiving stream.

DWQ believes that the most effective and equitable means of



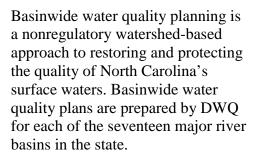
addressing color is to rely on the narrative aesthetic standard, as well as on complaints. DWQ will concentrate on a color reduction

strategy to reduce color in the South Fork Catawba River watershed in order to minimize complaints.

SECTION C: DWQ WATER QUALITY PROTECTION AND RESTORATION PROGRAMS

This section contains information on the many state programs that address water quality problems in North Carolina. Authority for some of the programs and responsibilities carried out by the NC Division of Water Quality (DWQ) are derived from a number of federal and state legislative mandates. The major federal authorities for the state's water quality program are found in sections of the Clean Water Act (CWA). State authorities are from state statutes (See Appendix 1 for details).

C-1 BASINWIDE PLANNING



Preparation of an individual basinwide water quality plan is a five-year process, which is broken down into four major phases. While these plans are prepared by DWQ, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first round of plans was completed in 1998. Plans are updated every five-years.

The purpose of Basinwide Water Quality Plans is to report to citizens, policy makers and the regulated community on: 1) the current status of surface water quality in each basin; 2) major water quality concerns and issues; 3) projected trends in development and water quality; 4) the long-range water quality goals for each basin and 5) recommended point and nonpoint source management options.

BASINWIDE RESPONSIBILITIES WITHIN DWQ'S WATER QUALITY SECTION

DWQ is the lead state agency for the regulation and protection of the state's surface waters. DWQ's mission is to maintain or restore aquatic environments to a sufficient quality to protect the existing and best intended uses of North Carolina's surface waters, and to ensure compliance with state and federal water quality standards. The major areas of responsibility within DWQ are water quality monitoring, permitting, planning, modeling

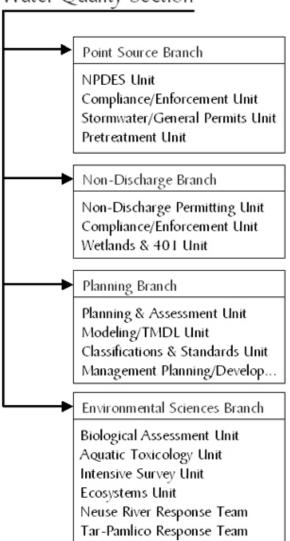




(wasteload allocations) and compliance oversight.

The division is comprised of four sections - Water Quality, Groundwater, Construction Grants and Loans and the Water Quality Laboratory - and includes the NC Wetlands Restoration Program. The Water Quality Section is comprised of a Planning Branch, Point Source Branch, Non-Discharge Branch and Environmental Sciences Branch.

Water Quality Section



Policy guidance is provided by the Environmental Management Commission.

PLANNING BRANCH

The Planning Branch is responsible for developing surface water quality standards and classifications, nonpoint source program planning, administering the basinwide planning program, modeling nonpoint pollution sources, developing use support ratings and supporting related GIS capabilities.

Branch staff also develop Total Maximum Daily Loads (TMDLs) and wasteload allocations for dischargers, provide primary computer modeling support and coordinate EPA water quality planning grants. The planning branch also coordinates implementation of the Albemarle-Pamlico National Estuary Program's (APNEP) Comprehensive Conservation and Management Plan (CCMP).

№ ENVIRONMENTAL SCIENCES BRANCH

The Environmental Sciences Branch (http://www.esb.enr.state.
nc.us) is responsible for all biological and chemical water quality monitoring, discharger coalition water quality monitoring, and evaluations including benthic macroinvertebrate monitoring (biomonitoring), fish tissue and fish communities studies.

The branch is also responsible for effluent toxicity testing and evaluations, biological laboratory certification, algal and aquatic macrophyte analyses, long-term



biochemical and sediment oxygen demand, and lakes assessments.

The branch interacts heavily in 305(b) use support assessments and in water quality standards review and development. The Neuse River and Pamlico River Rapid Response Teams are coordinated through the Environmental Sciences Branch. The Branch is in the process of developing simplified public access to water quality information via the World Wide Web.

→ POINT SOURCE BRANCH

The Point Source Branch is responsible for permitting, compliance and enforcement of wastewater discharges into state surface waters. Permitting and enforcement programs include the municipal industrial pretreatment program, state and federal stormwater programs and the National Pollutant Discharge Elimination System (NPDES) program.

Modeling is conducted to determine a receiving stream's ability to assimilate discharge and to protect a stream's uses, as well as its surface water standards.

Non-Discharge Branch

The Non-Discharge Branch is responsible for permitting, compliance and enforcement of wastewater systems not discharging directly into state surface waters. Examples include spray irrigation systems, sludge applications, reuse systems, animal waste management systems and groundwater remediation projects.

This branch also handles the section's activities related to wetlands including 401 certifications, wetland policy and mitigation and DOT and dredging project reviews.

Seven Regional Offices carry out activities such as wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and non-discharging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support, operator training and certification assistance.

In addition, regional office staff responds to water quality emergencies such as oil spills and fish kills, investigates complaints and provides information to the public.

BASINWIDE PLANNING GOALS

The goals of basinwide planning are to:

- identify water quality problems and restore full use to impaired waters;
- identify and protect high value resource waters;
- protect unimpaired waters while allowing for reasonable economic growth;
- develop appropriate management strategies to protect and restore water quality;
- assure equitable distribution of waste assimilative capacity for dischargers; and
- improve public awareness and involvement in the management of the state's surface waters.



BENEFITS OF THE BASINWIDE APPROACH

Several benefits of the basinwide planning approach include:

- Improved efficiency. The state's efforts and resources are focused on one river basin at a time.
- Increased effectiveness. The basinwide approach is in agreement with basic ecological principles.
- Better consistency and equability. By clearly defining the program's long-term goals and objectives, basinwide plans encourage consistent decision-making on permits and water quality improvement strategies.
- Increased public participation in the state's water quality protection programs. The basinwide plans are an educational tool for increasing public involvement and awareness about water quality issues.

 Increased integration of point and nonpoint source pollution assessment and controls. Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to ensure compliance with water quality standards.

BASINWIDE PLAN SCHEDULE

The management plan for a given basin is to be completed four to six months prior to the scheduled date for basinwide permit renewals so it can be used during the permit renewal decision-making process. Draft plans are due for completion a year in advance for public review.

| Basin | DWQ Biological Data Collection | River Basin Public Workshops | Public Mtgs. And Draft Out For Review | Final Plan Receives EMC Approval | Begin NPDES Permit Issuance |
|------------------|-----------------------------------|------------------------------------|---|--|-----------------------------------|
| Broad | Summer 2000 | 11/2001 | 9/2002 | 12/2002 | 7/2003 |
| Cape Fear | Summer 98 | 7/1999 | 4/2000 | 7/2000 | 12/2000 |
| Catawba | Summer 97 | 2/1999 | 9/1999 | 12/1999 | 3/2000 |
| Chowan | Summer 2000 | 3/2001 | 2/2002 | 5/2002 | 11/2002 |
| French Broad | Summer 97 | 5/1999 | 2/2000 | 5/2000 | 8/2000 |
| Hiwassee | Summer 99 | 10/2000 | 12/2001 | 3/2002 | 8/2002 |
| Little Tennessee | Summer 99 | 3/2001 | 11/2001 | 2/2002 | 10/2002 |
| Lumber | Summer 96 | 4/1998 | 2/1999 | 5/1999 | 11/1999 |
| Neuse | Summer 95 | 3/1997 | 9/1998 | 12/1998 | 1/1999 |
| New | Summer 98 | 6/1999 | 4/2000 | 7/2000 | 11/2000 |
| Pasquotank | Summer 2000 | 3/2001 | 2/2002 | 5/2002 | 12/2002 |
| Roanoke | Summer 99 | 4/2000 | 3/2001 | 7/2001 | 1/2002 |
| Savannah | Summer 99 | 10/2000 | 12/2001 | 3/2002 | 8/2002 |
| Tar-Pamlico | Summer 97 | 6/1998 | 4/1999 | 7/1999 | 1/2000 |
| Watauga | Summer 99 | 11/2000 | 12/2001 | 3/2002 | 9/2002 |
| White Oak | Summer 99 | 10/2000 | 7/2001 | 10/2001 | 6/2002 |
| Yadkin-Pee Dee | Summer 2001 | 11/2001 | 11/2002 | 3/2003 | 9/2003 |

Note: A basinwide plan was completed for all 17 basins during Round 1 (1993 to 1998).



BASINWIDE PLAN PREPARATION, REVIEW AND PUBLIC INVOLVEMENT

Preparation of an individual basinwide management plan is a fiveyear process that can be broken down into four major phases (see the chart below).

HOW TO GET INVOLVED

To assure that basinwide plans are accurately written and effectively implemented, it is important for local citizens and other stakeholders to participate in the planning process.

DWQ offers two opportunities for the public to participate in the process:

PHASE 1 (YEARS 1-3)

GOAL: Water Quality Data Collection and Identification of Goals and Issues

ACTIVITIES:

- · Identify sampling needs
- · Canvass for information
- · Coordinate with other agencies and local interest groups to establish goals and objectives and identify and prioritize issues
- Summarize data from ambient monitoring stations
- · Conduct biological monitoring activities
- Conduct special studies and other water quality sampling activities

PHASE 2 (YEARS 3-4)

GOAL: Data Assessment and Model Preparation

ACTIVITIES:

- Gather data from special studies to prepare models and TMDLs
- Develop preliminary pollution control strategies
- Coordinate with local stakeholders and other agencies
- · Develop use support ratings

PHASE 3 (YEAR 4)

GOAL: Preparation of Draft Basinwide Plan

ACTIVITIES:

- Develop draft basinwide plan based on water quality data, use support ratings, modeling data and recommended pollution control strategies
- Present preliminary findings at informal meetings and incorporate comments into draft plan

PHASE 4 (YEAR 4)

GOAL: Public Review and Approval of Plan

ACTIVITIES:

- · Circulate draft plan for review
- Hold public meetings after approval by NC Environmental Management Commission's Water Quality Committee
- Revise plan after public review period
- · Submit final document to Environmental Management Commission for approval
- Begin basinwide permitting and implementation at end of Year 5



- <u>Public workshops</u>: Held before writing the basinwide plans. DWQ staff present information about basinwide planning and the water quality of the basin. Participants then break into smaller groups where they can ask questions, share their concerns, and discuss potential solutions to water quality issues in the basin.
- <u>Public meetings</u>: Held after the Water Quality Committee of the Environmental Management Commission has approved the draft basinwide plan. DWQ staff present more detailed information about the draft basinwide plan and its major recommendations. Then, the public is invited to comment and ask guestions.
- <u>Public Comment Period</u>: Held after the Water Quality Committee of the Environmental Management Commission has approved the draft plan. The comment period is at least thirty days in length from the date of the first public meeting.

CONCLUSIONS

The basinwide approach establishes a process for taking significant steps toward addressing the major water quality issues facing North Carolina. This approach presents water quality issues in more manageable units defined both geographically (by river basin) and temporally (by five-year permit review/renewal and basin plan update intervals).

The basinwide NPDES permit schedule provides structure to the state's water quality program enabling program activities to be conducted in a more effective, efficient and consistent manner. The geographic breakdown allows for closer evaluation of water quality status, identification of impaired waters, and development of appropriate management strategies within each basin.

The five-year update intervals offer a realistic time frame for measuring the progress of pollution reduction strategies, and a mechanism has been developed to encourage broader public understanding and participation in water quality protection and the development of long-term management strategies.

FOR MORE INFORMATION...

For additional information, contact the Basinwide Program Coordinator, Water Quality Section, North Carolina Division of Water Quality, 1617 Mail Service Center, Raleigh, NC 27699-1617 (Phone 919-733-5083) or visit the Basinwide Planning web site at http://h2o.enr.state.nc.us/basinwide/.

C-2 NONPOINT SOURCE PROGRAMS



The state uses a balanced approach emphasizing both statewide nonpoint source (NPS) programs and on-the-ground management of individual watersheds in which waters are threatened or impaired. The state NPS program exists as a group of individual agency programs coordinated by DWQ.

DWQ works closely with, and relies on, other programs to meet water quality objectives. Five-year action plans (workplans) specify the goals and actions to be implemented statewide for each NPS category and the lead and supporting agencies for each goal. Each agency produces an annual report illustrating the progress it has made towards achieving its goals and objectives.

NPS programs and agencies also participate in the basinwide process, the state NPS Workgroup and NPS Teams. The NPS Workgroup has agency representatives from each NPS category (such as agriculture, construction, on-site wastewater), as well as representatives from major resource agencies. The NPS Workgroup serves as a coordinating group for many NPS efforts and is responsible for selecting Section 319 competitive projects.

The two approaches used to address nonpoint source pollution are prevention and engineered best management practices (BMPs). Some methods of pollution prevention include minimizing built-upon areas, protection of sensitive

areas, optimum site planning, use of natural drainage systems rather than curb and gutter, nutrient management plans, public/farmer education, storm drain stenciling and hazardous waste collection sites.

Engineered BMPs generally work by capturing, retaining and treating runoff before it leaves an area. Some commonly used BMP types include stormwater wetlands, wet detention ponds, water control structures, bioretention areas and infiltration basins. Higher levels of pollutant removal can often be achieved through a combination of different control systems. The primary advantage of engineered controls is that they are able to treat runoff from high density developments.

The current nonpoint source management trend involves a comprehensive "systems approach" that incorporates an integrated system of preventive and control practices to accomplish nonpoint pollution reduction goals. This approach emphasizes site planning, natural area protection and cost-effective engineered controls for high density areas.

SECTION 319 PROGRAM

Federal Section 319 funds from EPA are used to fund state agency staff positions and competitive grant projects. Staff positions supported by 319 funds are in agencies that deal with NPS activities such as urban stormwater, construction, on-site



wastewater, forestry, agriculture and solid waste. Individuals in these positions work to advance NPS program goals through assessment activities, education, regulation, technical assistance and other efforts. Section 319 funds are also provided

annually for competitive grant projects that demonstrate innovative BMPs.

The NPS Workgroup evaluates and selects the competitive projects that receive funding each year. These

| PROGRAM | LOCAL | STATE | FEDERAL | AGENCY LEGEND |
|---|--------------|----------------|---------|------------------------------|
| AGR | ICULTURE | | | |
| Agriculture Cost Share Program | SWCD | SWCC, DSWC | | COE |
| NC Pesticide Law of 1971 | | NCDA | | US Army Corps of Engineers |
| Pesticide Disposal Program | | NCDA | | DCM |
| Animal Waste Management | SWCD | DWQ, DSWC, CES | NRCS | NC Division of Coastal |
| Laboratory Testing Services | | NCDA | | Management |
| Watershed Protection (PL-566) | | | NRCS | DEH |
| 1985 ,1990 and 1995 Farm Bills | | | USDA | NC Division of |
| Conservation Reserve Program | | | | Environmental Health |
| Sodbuster/Swampbuster | | | | DFR |
| Conservation Easement | | | | NC Division of Forest |
| Wetland Reserve | | | | Resources |
| Water Quality Incentive Program | | | | DLR |
| , j | JRBAN | | | NC Division of Land |
| Coastal Stormwater Program | | DWQ | | Resources |
| ORW, HQW, NSW Management Strategies | | DWQ | | DOT |
| Water Supply Watershed Protection Program | city, county | DWQ | | NC Department of |
| Stormwater Control Program | city, county | DWQ | EPA | Transportation |
| CONS | STRUCTION | | | DSWC |
| Sedimentation and Erosion Control | ordinance | DLR, DOT | | NC Division of Soil and |
| Coastal Area Management Act | ordinance | DCM | | Water Conservation |
| Coastal Stormwater Program | | DWQ | | DSWM |
| ON-SITE WAS | | | | NC Division of Solid Waste |
| Sanitary Sewage Systems Program | county | DEH | | Management |
| SOLID WA | DWQ | | | |
| Resource Conservation and Recovery Act | | 50 | EPA | NC Division of Water Quality |
| Solid Waste Management Act of 1989 | city, county | DSWM | | NCDA |
| | RESTRY | DED | | NC Department of Agriculture |
| Forest Practice Guidelines National Forest Management Act | | DFR | USFS | NRCS |
| Forest Management Program Services | | DFR | USFS | US Natural Resources |
| Forestry Best Management Practices | | DFR | | Conservation Service |
| Forest Stewardship Program | | DFR | | SWCC |
| 1 orest Stewardship i rogram | MINING | DIK | | NC Soil and Water |
| Mining Act of 1971 | | DLR | | Conservation Commission |
| HYDROLOG | IC MODIFICA | | | SWCD |
| Clean Water Act (Section 404) | | DCM, DWQ | COE | Local Soil and Water |
| Rivers and Harbors Act of 1899 | | 2 5, 2 2 | COE | Conservation District |
| Dam Safety Permit | | DLR | | USDA |
| | TLANDS | | | US Department of Agriculture |
| Wetlands Restoration Program | | DWQ | | USFS |
| Clean Water Act (Sections 401 and 404) | | DWQ | COE | US Forest Service |
| Wetland Reserve Program | | | USDA | |
| | 11 | | | 1 |



projects, which are implemented around the state, can also include education and monitoring components.

In December 1998, DWQ and USDA Natural Resource Conservation Service (NRCS) prioritized projects for watershed restoration by 8-digit hydrologic units for the unified watershed assessment (UWA) program.

All proposals that rank above an "annual funding target" are sent to EPA along with the 319 grant application. DWQ reserves the right to make final changes to the list. Funding amounts and availability depend on EPA approval and yearly appropriations from Congress.

← FOR MORE INFORMATION...

More information on Section 319 grants can be found online at http://h2o.enr.state.nc.us/nps/319.htm or by contacting the DWQ - Planning Branch at:

1617 Mail Service Center Raleigh, NC 27699-1617 Tel: 919-733-5083, ext. 352

NON-DISCHARGE PERMITS

DWQ has a non-discharge program that reviews and permits systems using land application as a means of waste disposal. These systems include spray irrigation, animal waste management systems, rapid infiltration basins, trickling systems, land application of residuals programs, wastewater collection systems and beneficial reuse of wastewater systems.

The program, and all associated permits, is regulated by North Carolina General Statutes 143.215.1 and the Administrative Code Section 15A NCAC 2H .0200 - Waste Not Discharged to Surface Waters. These sections not only give DWQ the authority to issue permits; they also provide details on the permitting process and information that must be submitted with a permit application. The Non-Discharge Permitting Unit (NDPU) reviews and approves all systems.

Sanitary sewer collection systems used to collect the wastewater from NPDES discharge wastewater treatment facilities and non-discharge wastewater treatment facilities are both permitted by NDPU. The land application of residuals program and the distribution and marketing program are also permitted by NDPU, as required by EPA's 40 CFR Part 503 rules.

Non-discharge program permits are issued in several categories based on wastewater collection system type. Individual permits exist for gravity sewers, pump stations and force mains, pressure sewers and STEP systems. These applications require a final set of plans and specifications prior to the issuance of a permit.

DWQ also has a fast-track permitting system for gravity sewers. To help with the fast-track system, a list of Minimum Design Criteria was developed that includes the important requirements for the construction of a gravity sewer system.

The goals of the North Carolina nonpoint source management program include:

- Prioritize, target and restore designated uses of impaired waters.
- Protect or restore highly valued resource waters, such as High Quality Waters, Outstanding Resource Waters, Water Supply I, Water Supply II, and critical areas of Water Supply III and IV waters.
- Identify and implement the most cost-effective NPS management measures to improve and protect water quality.
- Coordinate efforts of the various NPS agencies within the state.
- Identify interagency programmatic deficiencies toward control of nonpoint sources of pollution, cultivate agencies' program capabilities to address these deficiencies, and develop new programs as needed.
- Integrate the NPS program with related management studies (e.g. Albemarle-Pamlico National Estuary Program).
- Monitor effectiveness of BMPs and management strategies in improving and protecting both surface and groundwater quality.



North Carolina's NPS priorities include:

- Working through the basinwide management planning process to develop and implement management strategies and TMDLs for 303(d) listed impaired waters
- The Use Restoration Waters Program
- Developing and implementing nutrient management strategies for the Neuse and Tar-Pamlico River basins and the Randleman Lake watershed
- Implementing requirements of the Coastal Zone Act Reauthorization Amendments (CZARA). This entails NPS management measures in coastal areas, wetlands restoration, developing strategies to protect waters to minimize future degradation, monitoring surface waters to pinpoint sources of pollution and gauging success of management strategies and BMPs
- Modeling to predict the effectiveness of proposed management scenarios

The fast-track permit requires a fourpage application, as well as an engineer seal and signature to insure that the gravity system will be built in accordance with state rules, regulations and the Minimum Design Criteria. Upon project completion, an engineer's certification must be submitted along with record drawings because the fast-track process does not require plans to be submitted prior to permit issuance. This has significantly reduced the permitting time.

The non-discharge program also requires wastewater systems that utilize land application for wastewater disposal to be permitted. The program has operational and monitoring requirements similar to those of the NPDES permit.

The primary difference is that treated effluent is not discharged to surface waters. It is usually discharged to a spray irrigation system for land application. Some other options for the land application of effluent include rapid infiltration basins and trickling systems. Rapid infiltration systems are designed to have a much more intense and high rate of land application than spray irrigation. Most rapid infiltration systems are located in the sandy regions of the state where soils can handle an increased application volume. Trickling systems, which are typically used for lower effluent volumes, are located statewide.

Every wastewater treatment facility in the State of North Carolina, including large NPDES systems, pretreatment systems and nondischarge systems, produce some form and amount of wastewater residuals. DWQ has a program that requires a permit for the land application of residuals. The program was developed around the EPA rules 40 CFR Part 257 and 40 CFR Part 503.

ANIMAL WASTE MANAGEMENT Regulations

In December 1992, the EMC adopted a rule modification (15A NCAC 2H .0217) establishing procedures for the proper management and reuse of animal wastes from intensive livestock operations. North Carolina was among the first states in the nation to adopt such procedures.

The goal of the rule was to eliminate discharge of animal waste from intensive animal operations. The rule modification says that if all criteria are met, and no waste is discharged to surface waters, then an individual DWQ permit is not required.

In order to be considered permitted, these facilities were required to have an approved animal waste management plan in place prior to December 31, 1997. Animal waste management plans for existing facilities must be certified by a technical specialist designated by the Soil and Water Conservation Commission. The standards and specifications of the USDA Natural Resources Conservation Service were the minimum criteria used for plan approval.

The 1996 General Assembly enacted Senate Bill (SB) 1217 (An Act to Implement Recommendations of the



Rule 15A NCAC 2H .0217 Applies to:

New, expanding or existing livestock operations with liquid waste management systems designed to serve the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds.

Blue Ribbon Commission on Agricultural Waste) that resulted in major changes to animal waste management. The bill required all facilities to apply for, and receive, a certificate of coverage under a general permit, in addition to the animal waste management plan required under 2H .0217.

The bill also stated that after January 1, 1997, all new and expanding facilities had to apply for, and receive, coverage under the appropriate General Permit prior to construction. Also beginning January 1, 1997, at least 20% of existing facilities had to receive coverage under the General Permit for swine, cattle and poultry systems each year. Facilities with unique circumstances, compliance problems or that utilize innovative technology - those that do not fall under the general permitting system - would be issued individual permits.

The act required poultry operations with dry litter systems to develop and comply with an animal waste management plan by January 1, 1998. Plans did not have to be as comprehensive as those for wet systems or be certified by a technical specialist. The deadline was extended to January 1, 2000 by Senate Bill 352 in 1997.

During the summer of 1995, Senate Bill (SB) 1080 (the Swine Farm Siting Act) established greater buffer distances for swine houses, lagoons and land application areas were sited after October 1, 1995. House Bill (HB) 515 subsequently modified the siting requirements established in SB 1217 so that setbacks would only apply to facilities built or expanded after August 27, 1997.

When SB 1217 became effective on October 1, 1996, the distance from a swine house or lagoon to any property boundary on which an occupied residence was located increased from 100 to 500 feet. Beginning June 21, 1996, any person wishing to construct a new or expanded swine farm must notify all adjoining property owners.

In addition, notification requirements for new and expanding operations were expanded to include the county manager, or chair of the board of commissioners, and local health department director. HB 515 also allowed counties to adopt zoning ordinances for swine farms having a design capacity greater than or equal to 600,000 pounds steady state live weight. County ordinances cannot be designed to exclude all swine farms of this size from their jurisdictions, nor can they prohibit the continued existence of a farm.

In 1998, House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register a contractual relationship with an integrator with DWQ.

Senate Bill 1217 stated that:

- setbacks of 2,500 feet would now apply to outdoor recreational facilities, parks, historic properties and child care centers;
- lagoons must be setback 500 feet from any well providing water for human consumption, except those wells supplying water to the same parcel(s) or adjacent parcels of land under common ownership on which the swine house or lagoon is located;
- a 75-foot setback is required from the outer perimeter of the land application area, from property boundaries on which an occupied residence is located and from any perennial stream or river (other than an irrigation ditch or canal); and
- no component of the liquid waste management system may be constructed within the 100-year flood plain.



Senate Bill 1080 required buffer widths to be:

- at least 1,500 feet from a new swine house or lagoon to the nearest occupied residence;
- at least 2,500 feet from a new swine house or lagoon to a school, hospital or church:
- at least 100 feet from a new swine house or lagoon to a residential property line;
- at least 50 feet from the outer perimeter of the land application area to a residential property line; and
- at least 50 feet from the outer perimeter of the land application area to a perennial stream or river.

In 1999, House Bill 1160 extended the moratorium on new construction or expansion of swine farms, required DENR to develop an inventory of inactive lagoons and requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

Operator Training and Certification

The North Carolina General Assembly ratified Senate Bill 974 (NCGS 143-215.74C - E) on July 29, 1995. The bill required DENR, in cooperation with the Cooperative Extension Service, to develop and administer a training and certification program for operators of swine facilities with more than 250 swine and that land-apply animal waste. DENR assigned the task of developing and administering this program to the Technical Assistance and Certification Unit of the Water Quality Section.

The purpose of the program is to reduce nonpoint source pollution associated with the operation of animal waste management systems. Animal waste management systems are defined as a combination of structural and nonstructural practices that collect, treat, store or apply animal waste to the land. Under the bill, all animal operations with 250 or more swine (*Sus scrofa*) are required to designate an Operator in Charge who would have primary responsibility for the operation of the animal waste management system.

The state established a steering committee that included representatives from the animal agriculture industry, environmental groups, North Carolina Department of Agriculture, Natural Resources Conservation Service, NC Division of Soil and Water Conservation, North Carolina Cooperative Extension Service and Division of Water Quality. The committee was responsible for developing the instructional manual and exam questions for the training and certification program.

The manual is currently used in training sessions that are conducted by the Cooperative Extensive Service in each county. Also involved in training are personnel from the NC Department of Agriculture, Natural Resources Conservation Service and pork producers. The examination aspect of the program is administered by the Technical Assistance and Certification Unit in eighteen locations throughout the state. Operator training sessions began in April 1996 while examinations started in May 1996.

Individuals who wish to become certified animal waste management system operators must attend a minimum of ten training hours - with six triennial continuing education hours - and demonstrate competence in the operation of animal waste management systems by passing an examination. Training and certification requirements must be completed once every five years.



Approximately 4,000 animal operations statewide are required to designate an Operator in Charge.

Inspection and Enforcement

Prior to July 1995, DWQ's limited compliance resources were primarily used to register existing facilities, insure that new and existing facilities had approved waste management plans and respond to citizen complaints.

Following major lagoon dike breaks in late June and July 1995, DWQ and DENR's natural resources divisions made a major commitment to inspect all animal operations. As of December 1, 1995, over 4,000 operations, many with problems, were inspected.

DWQ is currently working to get problem facilities into compliance. Efforts include technical assistance, issuance of Notices of Violations, court orders and other appropriate enforcement actions.

Senate Bill 1217, ratified on June 21, 1996, included the recommendations of a Blue Ribbon Commission on Animal Waste which was convened to address issues related to the management of waste generated by intensive livestock operations in North Carolina. The bill requires the permitting of all animal waste management facilities and requires inspection of those permitted facilities. It also requires the certification of animal waste management system operators.

On April 22, 1999, Governor Hunt unveiled a plan to improve hog waste treatment and management in North Carolina by converting swine lagoon and sprayfields to more effective treatment systems. The plan included three major components: closing and cleaning up inactive lagoons, establishing performance standards for new facilities and converting active facilities to new technology.

On July 1, 1999, enforcement decisions for animal wastewater collection systems included operation and maintenance components. Evaluations included whether operators conducted routine inspections, performed regular line cleaning and right-of way maintenance, kept records of problems and repairs, maintained back-up equipment for pump stations and implemented a schedule to address ongoing problems. The policy was designed to prevent spills and overflows through early recognition of trouble spots and preventative maintenance.

← FOR MORE INFORMATION...

More information on Non-Discharge Permits can be obtained online at http://h2o.enr.state.nc.us/ndpu/ndpupro.html or by contacting the Non-Discharge Permitting Unit at:

1617 Mail Service Center Raleigh, NC 27699-1617 Telephone: (919) 733-5083 Fax: (919) 715-6048

URBAN AND DEVELOPING AREAS PROGRAM

DWQ stresses a source reduction and pollution prevention approach for stormwater quality management. This approach is based upon the recognition that the quality of



stormwater leaving an area is dependent on the levels of pollutants available for collection by runoff.

Reducing source areas or concentrations reduces loading. On a local level, this type of management program may include various components, such as sedimentation and erosion control programs for disturbed areas, land use planning and ordinance controls in developing areas, municipal programs for recycling and hazardous waste collection, public education and training programs, spill failure/containment programs, programs to detect and remove illicit connections where non-stormwater is introduced to stormwater flows and storm sewer systems and educational programs.

These methods are considered the most efficient and effective from a cost and management standpoint. However, depending on the level of imperviousness and pollutants of concern, engineered stormwater control structures for stormwater management may also be needed.

← FOR MORE INFORMATION...

Contact the DWQ Stormwater and General Permits Unit for information on the Urban and Developing Areas Program:

1617 Mail Service Center Raleigh, NC 27699-1617 Telephone: (919) 733-5083

STATE STORMWATER MANAGEMENT PROGRAMS

DWQ administers state stormwater programs that apply to development activities that may impact sensitive waters of the state. While the specific requirements may vary within the different state stormwater program areas, they are all based on similar principles and strategies for stormwater control.

Development activities subject to the state stormwater requirements can meet the provisions of the rules by maintaining low density development, where the percentage of built-upon area on the project site is below a given allowable limit. This limit on built-upon area leaves remaining acreage in a natural condition (e.g., grass, trees and other vegetation) to serve as a buffer between impervious surfaces and surface waters and to allow filtering of pollutants.

Low density development is viewed as the preferred method of control by DWQ and as a source reduction/pollution prevention alternative. In addition, the state recognizes that there are some situations where low density projects may not be possible or desirable.

Where there is no alternative to higher density development, such projects may comply with the rules by using appropriately designed, constructed and maintained engineered stormwater control devices to capture and treat defined stormwater volumes. The following pages outline each area of state stormwater coverage.



◆ URBAN STORMWATER MANAGEMENT PROGRAM

In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the EPA to develop regulations for stormwater discharges associated with industrial activities and large and medium municipal separate storm sewer systems (MS4s). Large and medium MS4s are defined as those that serve incorporated areas with populations greater than 100,000. These NPDES stormwater regulations became effective in December 1990. Authority to administer these regulations has been delegated by EPA to DWQ.

The goal of the regulations is to prevent stormwater runoff pollution by controlling pollutant sources. By defining potential pollutant sources and establishing controls of these sources to reduce and minimize pollutant availability, DWQ hopes to see an improvement in the water quality of receiving streams.

The municipal NPDES stormwater-permitting program requires each municipality to develop and implement a comprehensive stormwater management program. Programs are designed to reduce the discharge of stormwater pollutants to the maximum extent practicable (MEP). MEP is defined individually for each permitted municipality. Currently permitted MS4s include Charlotte, Durham, Greensboro, Raleigh, Winston-Salem and Fayetteville/Cumberland County.

Stormwater discharges directly related to manufacturing, processing

or raw materials storage at certain industrial facilities are also subject to NPDES stormwater permitting (construction activities disturbing more than 5 acres are considered an industrial activity under the NPDES stormwater program). The types of industrial activities subject to permitting are typically defined by Standard Industrial Classification (SIC) codes that are developed by the federal Office of Management and Budget

A complete definition of "stormwater discharge associated with industrial activity", including a comprehensive listing of subject industries, can be found in 40 CFR 122.26. Industrial facilities discharging through a permitted MS4 are still required to obtain their own NPDES stormwater permit.

The permitting requirements described above represent Phase I of the NPDES stormwater program. Phase II, which is currently under development, will address stormwater discharges from urban areas with populations under 100,000; smaller construction sites and retail, commercial and residential activities.

↑ COASTAL NONPOINT POLLUTION CONTROL PROGRAMS

As part of the Coastal Zone Act Reauthorization Amendments of 1990, Congress enacted Section 6217 entitled "Protecting Coastal Waters." This provision requires states with coastal zone management programs (including North Carolina) that have received Federal approval under Section 306 of the Coastal



Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs.

Coastal nonpoint pollution control programs provide additional control over sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include agriculture, forestry operations, urban and developing areas, marinas, hydromodification projects, and wetlands and riparian areas.

Coastal Nonpoint Pollution Control Programs are not intended to supplant existing coastal zone management programs and nonpoint source management programs. Rather, they are to serve as an update and expansion of existing nonpoint source management programs and are to be coordinated closely with the existing coastal zone management programs.

No single process is established for adoption of new BMPs. Rather, the programs defer to administrative procedures of the agencies that oversee the activities of each constituent nonpoint source category within the coastal program.

↑ Coastal Stormwater Management

The Environmental Management Commission (EMC) and DWQ administer stormwater management programs to protect sensitive coastal resources. The regulations apply to development activities that require either a Coastal Area Management Act (CAMA) major permit or a Sediment/Erosion Control Plan (development disturbing more than one acre).

These programs began in the early 1980s through water quality reviews of CAMA major permits. Specific stormwater regulations for coastal situations were first developed and adopted by the EMC in November 1986. Modifications to the rules were made in 1987 and became effective January 1, 1988. These regulations are administered by DWQ's Water Quality Section.

One of the most important features of these regulations is the expansion of applicability of stormwater controls to development activities within the 20 CAMA coastal counties (Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington).

While near-water impacts of stormwater were addressed in the original rules, the expanded area of coverage in the 1988 rules allows the state to address cumulative impacts of stormwater runoff throughout the coastal zone, providing fuller protection of both shellfish waters and coastal water quality in general.

NC coastal stormwater regulations promote source minimization through low density development. The low density option of the regulations sets a built-upon area limit of 25 percent in areas draining



to SA waters and 30 percent for other coastal areas.

Development exceeding these thresholds is required to have an engineered stormwater management system. The regulations also address appropriate sizing of stormwater management systems.

For developments adjacent to SA waters, infiltration systems are required and retain the runoff from 1.5 inches of rainfall, whereas development in other areas must control one inch of rainfall. Wet detention ponds are allowed in areas that are not adjacent to SA waters and must be sized for 85 percent TSS removal.

In addition, alternative stormwater management systems are allowed if they provide equivalent protection.

№ WATER SUPPLY PROTECTION PROGRAM

Approximately 50 percent of North Carolina's population depend on surface water supplies for drinking, commercial, and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health.

Consequently, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (House Bill 156). This Act requires all local governments that have land use jurisdiction within surface water supply watersheds, or a portion thereof, to be responsible for

implementation and enforcement of nonpoint source management requirements related to urban development according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural and Department of Transportation activities.

The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992, and amended effective August 1, 1995 to provide greater clarity and flexibility to local governments.

The purpose of the Water Supply Protection Program is to provide an opportunity for communities to work with the state to strengthen protection of their water supplies from pollution.

There are five water supply classes that are defined according to the amount and types of permitted point source discharges, as well as a requirement to control nonpoint sources of pollution. By classifying a watershed as a water supply watershed, a local government and adjacent jurisdictions within the watershed will take steps to control NPS pollution at its sources and thereby reduce the potential for pollutants to contaminate their drinking water supplies. In turn, the state limits the point source discharges that can locate within the watershed, thereby reducing the potential for water supply contamination.



This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the possible pollutants has water quality standards.

The Water Supply Protection
Program is administered by the
Planning Branch of DWQ's Water
Quality Section. DWQ staff
coordinates with the Division of
Environmental Health, which
certifies that a proposed
reclassification is suitable for a
drinking water supply, as well as
DENR regional offices that are
responsible for water quality
sampling in the proposed water
supply.

Implementation of the act and adoption of the rules have entailed the creation of several water supply surface water classifications including WS-I to WS-V. Watersheds draining to waters classified WS carry some restrictions on point source discharges and on many land use activities including urban development, agriculture, forestry and highway sediment control.

As more is learned about the types and effects of pollutants in our drinking waters, the state will proceed to adopt additional water quality standards.

◆ FOR MORE INFORMATION...

Additional information on the state's Stormwater Management Programs can be obtained from the following sources:



Information can be found online at DWQ's Stormwater and General Permits Unit web site located at http://h2o.enr.state.nc.us/su/stormwater.html. Additional resources, including those listed below, can be obtained by contacting the at:

1617 Mail Service Center Raleigh, NC 27699-1617 Telephone: (919) 733-5083

- Stormwater Management Guidance Manual, 1993, Cooperative Extension Service
- Stormwater Management in North Carolina: A Guide for Local Officials, 1994, Land-of-Sky Regional Council, Asheville, NC (Eaker, 1994)
- Stormwater Fact Sheets by Land-of-Sky Regional Council, 1994
- Stormwater Problems and Impacts: Why all the Fuss?
- Stormwater Control Principles and Practices
- Stormwater Management Roles and Regulations
- Local Stormwater Program
 Elements and Funding Alternatives
- Statewide Stormwater Conference, 1994
- Statewide Workshops on The Water Supply Protection Program, 1994-1995
- Statewide Workshops on Stormwater Management, 1995
- Municipal Pollution Prevention
- Managing Stormwater in Small Communities: How to Get Started
- Maintaining Wet Detention Ponds
- Plan Early for Stormwater in Your New Development



- How Citizens Can Help Control Stormwater Pollution
- Stormwater Best Management Practices, 1995, NC Division of Environmental Management
- North Carolina Stormwater Site Planning Guidance Manual, 1998, NC Division of Water Quality
- DWQ, Stormwater and General Permits Unit: (919) 733-5083

Coastal Nonpoint Pollution Control Program

The following management agencies are responsible for coordinating coastal nonpoint pollution controls:

 General water quality, urban runoff, wetlands and groundwater NC Division of Water Quality http://h2o.enr.state.nc.us/

1617 Mail Service Center Raleigh NC 27699-1617

Tel: 919-733-7015 Fax: 919 -733-9919

• Agriculture

NC Division of Soil and Water Conservation http://www.enr.state.nc.us/DSWC/ 1614 Mail Service Center Raleigh, NC 27699-1614 Tel: 919-733-2302 Fax: 919-715-3559

• Construction and Mining

NC Division of Land Resources http://www.dlr.enr.state.nc.us/
1612 Mail Service Center Raleigh, NC 27699-1612
Tel: 919-733-4574

On-site wastewater treatment and solid waste disposal

NC Division of Environmental Health

http://www.deh.enr.state.nc.us/ 1642 Mail Service Center Raleigh, NC 27699-1642 Tel: 919-733-2895 • Forestry

NC Division of Forest Resources http://www.dfr.state.nc.us/
1616 Mail Service Center Raleigh, NC 27699-1616
Tel: 919-733-2162

Fax: 919-733-2835

• Transportation

NC Department of Transportation http://www.dot.state.nc.us/PO Box 25201
Raleigh NC 27611-5201
Tel: 919733-2920

FAX: (919)733-9810

• Marinas

NC Division of Coastal Management http://dcm2.enr.state.nc.us/
1638 Mail Service Center Raleigh, NC 27699-1638
Tel: 919-733-2293

Fax: 919-733-2293

• Hydromodification projects

NC DWQ Wetlands Unit http://h2o.enr.state.nc.us/ncwetlands/1621 Mail Service Center Raleigh, NC 27699-1621 Tel: 919-733-1786

Coastal Stormwater Management

Information on NC's coastal stormwater management program can be obtained by contacting DWQ at 919-733-5083.

Water Supply Protection Program

Information on the NC Water Supply Watershed Protection Program can be found at http://h2o.enr.state.nc.us/wswp/index.html or by contacting the NC Water Supply Watershed Protection Program at:

1617 Mail Service Center Raleigh, NC 27699-1617 Tel; 919-733-5083 FAX: (919) 715-5637



WETLANDS CERTIFICATION PROGRAM

Several important state and federal wetland protection programs have been initiated within DWQ and DENR. In addition, provisions of the 1985 and 1990 Farm Bills should also help to reduce wetlands impacts.

For example, agriculture conversions should be reduced by the "swampbuster" provision of the 1985 Farm Bill, which uses incentives such as USDA subsidies, loans and price supports to encourage farmers not to convert wetlands to agriculture. In addition, a Wetland Reserve Program was established by the 1990 Farm Bill with the goal of allowing one million acres of prior converted wetlands to revert to wetlands by 1995.

◆ SECTION 401 WATER QUALITY CERTIFICATION (FROM CWA)

Section 401 of the federal Clean Water Act states that no federal agency can issue any license or permit to conduct any activity that may result in a discharge to navigable waters, unless the state in which the discharge may occur certifies that the discharge will not result in a violation of any state water quality or related standards.

The NC Division of Water Quality is responsible for the issuance of 401 Water Quality Certifications. A Section 401 certification is required for discharges into surface waters or wetlands and for projects that require a section 404 permit. A federal permit cannot be issued if a 401 certification is denied. Any

conditions added to the 401 certification become conditions of the 404 permit. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 CAMA counties.

№ NORTH CAROLINA DREDGE AND FILL ACT (1969)

This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake." This law is administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

▶ FOR MORE INFORMATION...

More information on the NC Wetlands Certification Program can be found online at http://h2o.enr.state.nc.us/ncwetlands/ or by contacting the DWQ Wetlands/ 401 Water Quality Certification Unit:

1621 Mail Service Center Raleigh, NC 27699-1621 Tel: 919-733-1786

GROUNDWATER PROGRAM

Although groundwater resources in North Carolina are generally of good quality, nonpoint sources of pollution can contaminate aquifers rendering the water unfit as a water supply source.

The DWQ Groundwater Section is the designated lead agency in the state for groundwater protection. The mission of DWQ's Groundwater Section is to administer a program that protects and preserves the quality of groundwater resources for beneficial use by the citizens of the



state. The primary goals of the program are to prevent groundwater pollution, respond to contamination when it occurs and promote resource restoration through effective management of the resource.

Groundwater Section responsibilities include groundwater quality classification and standards, implementing groundwater cleanup requirements, promoting resource restoration, reviewing permits for wastes discharged to groundwater, well construction rules, underground injection control and groundwater quality monitoring.

The Groundwater Section consists of a central office, seven regional field offices and drill crew. The following programs are administered by the Groundwater Section.

To prevent pollution, groundwaters of the state have been classified and standards developed. Nonpoint source land and subsurface, non-discharge waste disposal activities are regulated, and groundwater self-monitoring requirements imposed on any activity which has the potential to violate standards at a 250-foot compliance boundary.

A Wellhead Protection Program assists local communities in establishing programs to delineate groundwater recharge areas surrounding water supply wells and protect these areas from nonpoint sources that could contaminate water supplies.

Over the past decade the biggest threat to groundwater has been

leaking underground storage tanks. The Groundwater Section manages both federal and state trust funds to assist responsible parties in the cleanup of tank contaminants, and maintains an investigation team to determine the source of contamination at incident sites.

Although the Groundwater Section does not directly manage any given nonpoint pollution source, it is able to advance the protection and restoration of groundwater resources by promoting the adoption of useful new BMPs or the revision of existing BMPs by agencies that do directly manage the various NPS categories.

WELL CONSTRUCTION PROGRAM

The Groundwater Section has established regulations that specify standards by which water supply wells and monitor wells are constructed. Standards specify that all drilling contractors and pump installers must be registered, and that a report must be submitted for any well constructed or abandoned. DWQ's regional field offices perform well inspections and investigate cases of improper well construction.

The Groundwater Section also assists with the newly formed Well Driller Certification Commission that issues permits for certain types of monitor wells.

№ Non-Discharge Program

The Water Quality Section of DWQ administers a non-discharge program to prevent pollution from wastes that are not discharged to surface water.



The Groundwater Section is responsible for reviewing and recommending permit conditions and limitations on any non-discharge project that might have an impact on groundwater. Such projects include wastewater spray irrigation systems, some types of groundwater remediation systems, land application of sludge, surface waste impoundments and other systems that potentially impact groundwater.

The On-Site Wastewater Section of the Division of Environmental Health administers the subsurface disposal of sewage. The Groundwater Section is responsible for reviewing and recommending permit conditions and limitations on any subsurface sewage disposal project that might have an impact on groundwater. Projects include all industrial process wastewater systems, public and community wastewater systems that treat over 3,000 gallons per day.

↑ COMPLIANCE MONITORING PROGRAM

This program includes the management of facilities that are required to monitor groundwater as part of their non-discharge permits. A typical facility under this program will have a number of monitor wells around a waste disposal area that are sampled quarterly to determine whether an activity is impacting groundwater. If the Groundwater Section finds a facility is causing an impact, the facility will be required to assess the extent of the impact and modify activities to stop the impact.

◆ UNDERGROUND INJECTION CONTROL

The Underground Injection Control (UIC) program, established under the Federal Safe Drinking Water Act, controls the underground injection of fluid or solid substances through a well. The Groundwater Section issues permits for Class V injection wells used in operations, such as heat pumps, and for closed-loop groundwater remediation systems.

Except for those actions that are permitted, the State of North Carolina has determined that injecting wastes underground through wells presents a hazard to the public welfare, and has prohibited this activity.

← GROUNDWATER RULES

North Carolina's rules for groundwater protection (15A NCAC 2L) establish classifications for all groundwater resources and establish groundwater quality standards. DENR appointed a workgroup in November 1995 to develop a risk-based assessment approach for all contaminated sites, and to make recommendations regarding the clean up of these sites. This effort is continuing.

North Carolina recently implemented temporary rules for a risk-based approach to assess and cleanup groundwater discharges resulting from petroleum underground storage tank releases. The intent of the rules is to provide the state with flexibility in determining the need for, and extent of, cleanup efforts based on the risk that a release may pose to human health and the environment.



This risk-based approach and assessment to the cleanup of environmental contamination allows limited resources to be directed toward those sites that pose the greatest threat to human health and the environment. The temporary rules became permanent in 1998

▶ FOR MORE INFORMATION...

Information on NC's Groundwater Program is available online at http://gw.ehnr.state.nc.us/ or by contacting the Groundwater Section at:

1636 Mail Service Center Raleigh NC 27699-1636 Tel: 919-733-3221

Fax: 919-715-0588





C-3 CLASSIFICATIONS AND STANDARDS



North Carolina has established a water quality classification and standards program pursuant to General Statute 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B. 0100 - Procedures for Assignment of Water Quality Standards.

WATER QUALITY STANDARDS

Waters in North Carolina were classified for their "best usage" beginning in the early 1950s, with classification and water quality standards for all the state's river basins adopted by 1963. This effort entailed: 1) the identification of waterbodies (including all named waterbodies on USGS 7.5 minute topographic maps); 2) river basin studies to document sources of pollution and appropriate best uses; and 3) formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards are applied to provide

protection of uses from both point and nonpoint source pollution.

STATEWIDE CLASSIFICATIONS

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters.

A mountain stream, for example, might have a C Tr classification, where C is the primary classification followed by a Tr (Trout) supplemental classification.

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS

| Class | Best Uses |
|----------|--|
| SA | Waters classified for commercial shellfish harvesting. |
| C and SC | Aquatic life propagation/protection and secondary recreation. |
| B and SB | Primary recreation and Class C uses. |
| ws | Water Supply watershed: There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located. |



SUPPLEMENTAL CLASSIFICATIONS

| CLASSIFICATIONS | | |
|-----------------|---|--|
| Class | Best Uses | |
| Sw | Swamp Waters: Waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen. | |
| HQW | High Quality Waters: Waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas or WS-I and WS-II water supplies. | |
| ORW | Outstanding Resource Waters: Unique and special surface waters which are unimpacted by pollution and have some outstanding resource values. | |
| NSW | Nutrient Sensitive Waters: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. | |
| Tr | Trout Waters: Provides protection to freshwaters for natural trout propagation and survival of stocked trout. | |

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. The standards for C and SC waters establish the basic protection level for all state surface waters.

With the exception of Sw, all of the other primary and supplemental classifications have more stringent standards than C and SC, and therefore require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare and endangered aquatic species. These waters may be designated as HQW or ORW.

Special HQW protection management strategies are intended to prevent any future degradation of water quality from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities that expand beyond their currently permitted loadings address oxygenconsuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Development activities that require a Sedimentation and Erosion Control Plan or approved local erosion and

Criteria for HOW

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native and special native trout waters or primary nursery areas by the Wildlife Resources Commission.
- Critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture.
- Waters classified by DWQ as WS-I, WS-II and SA are HQW by definition, but these waters are not specifically assigned the HQW classification because the standards for WS-I, WS-II and SA waters are at least as stringent as those for waters classified HQW.



sedimentation control program, and that drain to and are within one mile of HQWs, must control runoff using either a low density or high density option.

In addition, the Division of Land Resources requires more stringent sedimentation controls for landdisturbing projects within one mile of, and draining to, HQWs.

↑ OUTSTANDING RESOURCEWATERS

A small percentage of North Carolina's surface waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource designation.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted and stormwater controls for most new developments are required. In some cases, unique water or resource

characteristics may require a customized ORW management strategy to be developed.

By Rule, Outstanding Resource Waters:

- · have outstanding fisheries resource; or
- have a high level of water-based recreation; or
- have a special designation such as National Wild and Scenic River or a National Wildlife Refuge; or
- are within a state or national park or forest; or
- have special ecological or scientific significance.

FOR MORE INFORMATION...

A full description of the state's water quality standards, along with primary and supplemental classifications, is available in the document entitled: Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina available through DWQ.

Information on this subject is also available online at:

http://h2o.enr.state.nc.us/wqhome.html and

http://h2o.enr.state.nc.us/hiqualty.html



C-4 WATER QUALITY MONITORING



DWQ's water quality monitoring program integrates biological, chemical and physical data assessments to provide information for basinwide planning.

BENTHIC MACROINVERTEBRATE MONITORING

Benthic macroinvertebrates are organisms, primarily aquatic insect larvae, which live in - and on - the bottoms of rivers and streams. The use of macroinvertebrate data has proven to be a reliable water quality monitoring tool because most macroinvertebrates are immobile and sensitive to subtle changes in water quality. Benthic communities also respond to, and show the effects of, a wide array of potential pollutant mixtures.

FISH MONITORING

The condition of a fish community is one of the most meaningful indicators of ecological integrity to the public. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web (such as macroinvertebrates) will also affect the abundance, species composition and condition of fish populations.

LAKES ASSESSMENT PROGRAM (INCLUDING PHYTOPLANKTON)

Lake assessments have been conducted at publicly accessible lakes, lakes that supply domestic drinking water and lakes in which water quality problems have been observed.

The North Carolina Trophic State Index (NCTSI) is a measure of nutrient enrichment and productivity and lake assessment data is used to determine the general health, or trophic state, of each lake. Lakes are also evaluated on whether the designated uses of the lake have been threatened or impaired by pollution.

AQUATIC TOXICITY MONITORING

Acute and/or chronic toxicity tests are used to determine the toxicity of discharges in areas with sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown to be predictive of discharge effects on receiving stream populations (Eagleson et. al., 1990).

SEDIMENT OXYGEN DEMAND

If benthic sediments show signs of oxygen depletion, then a sediment oxygen demand (SOD) study may be performed. During a SOD study, each stream reach is divided into a series of model segments. The



number of stream segments that must be evaluated through an intensive survey depends on the individual study and the spatial resolution desired. Raw data from these studies is available on request.

Major NC monitoring programs include:

- Benthic macroinvertebrate monitoring
- Fish population and tissue monitoring
- Lakes assessment (including phytoplankton monitoring)
- Aquatic toxicity monitoring
- Chemical/Physical characterizations
- Sediment oxygen demand
- Ambient monitoring system

AMBIENT MONITORING SYSTEM

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine (saltwater) water quality monitoring stations (about 420 statewide) strategically located for the collection of physical and chemical water quality data (or parameters).

Water quality parameters are arranged by freshwater or saltwater waterbody classification and corresponding water quality standards. Under this arrangement, Class C waters are assigned minimum monthly parameters with additional parameters assigned to waters with classifications such as trout waters and water supplies.

FOR MORE INFORMATION...

Information on NC's water quality monitoring efforts is available online at http://www.esb.enr.state.nc.us/ or by contacting:

DWQ Environmental Sciences Branch 3800 Barrett Drive PO Box 27687 Raleigh, NC 27609 Tel: 919-571-4700

FAX: 919-571-4718

C-5 USE SUPPORT RATINGS



DWQ classifies waters according to their best intended uses. Determining how well a waterbody supports its designated uses (*use support* status) is another important method of interpreting water quality data and assessing water quality.

Surface waters (streams, lakes and estuaries) are rated as *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection or swimming) are fully supported, partially supported or not supported. Waters that do not have data with which to determine their use support are listed as *not rated* (NR).

For instance, waters classified for fishing and water contact recreation (Class C for freshwaters and SC for saltwaters) are rated as FS if data used to determine use support (such as chemical/physical data collected at ambient sites or benthic macroinvertebrate bioclassifications) does not exceed specific criteria. However, if these criteria are exceeded, then the waters would be rated as PS or NS, depending on the degree of exceedence.

Waters that are either PS or NS are considered impaired and are rated based on specific criteria discussed more fully below. There must be a specified degree of degradation before a waterbody is considered impaired. This differs from "impacted" which can refer to any

noticeable or measurable change in water quality, good or bad.

INTERPRETATION OF DATA

Water quality assessments involve an evaluation of available water quality data to determine a waterbody's use support rating. In addition, DWQ tries to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for impaired waters. Data used in use support assessments include biological data, chemical/physical data, lakes assessment data and shellfish sanitation surveys from the NC Division of Environmental Health (as appropriate).

Although there is a general procedure for analyzing data and determining a waterbody's use support rating, each waterbody is reviewed individually and best professional judgment is applied during the determination process.

Interpretation of use support ratings compiled by DWQ should be done with caution. The methodology used to determine the ratings must be understood, as should the purpose for which the ratings were generated. The intent of use support assessments is to gain an overall picture of water quality, to describe how well these waters support the uses for which they were classified and to document the relative contribution made by different pollution sources.



The data is not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important not to manipulate the data to support policy decisions beyond the accuracy of the data. For example, in many areas, nonpoint source pollution has been determined to be the greatest source of water quality degradation.

However, point source control measures may also be necessary. All categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

ASSESSMENT METHODOLOGY FRESHWATER STREAMS

Many types of information are used to determine use support assessments and to determine causes and sources of use support impairment. Therefore, a use support data file is maintained for each of the 17 river basins.

In these files, stream segments are listed as individual records. Existing data pertaining to a stream segment is entered into its record. In determining the use support rating for a stream segment, corresponding ratings are assigned to data values where appropriate.

The following data and corresponding use support ratings are used in the process. Note that the general methodology for using data and for translating values to use

support ratings corresponds closely to the 305(b) guidelines, with some minor modifications.

The following methods were used for developing the 2000 305(b) report and several basinwide plans prior to 2000. Improved methods are being developed for basin plans produced in 2000 and beyond, and for 305(b) reports in 2002 and beyond.

→ MONITORING DATA

Benthic Macroinvertebrate Bioclassification

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups *Ephemeroptera*, *Plecoptera* and *Trichoptera* (EPTs). In addition, the Biotic Index (BI) summarizes tolerance data for all taxa in each collection.

| Bioclassifications are translated to use support ratings as follows: | | | |
|--|----------------------|--|--|
| Bioclassification | Rating | | |
| Excellent | Fully Supporting | | |
| Good | Fully Supporting | | |
| Good-Fair | Fully Supporting | | |
| Fair | Partially Supporting | | |
| Poor | Not Supporting | | |

Fish Community Structure

DWQ uses the North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition.



| The index is translated to use support ratings as follows: | | | |
|--|----------------------|--|--|
| NCIBI | Rating | | |
| Excellent | Fully Supporting | | |
| Good | Fully Supporting | | |
| Good-Fair | Fully Supporting | | |
| Fair | Partially Supporting | | |
| Poor | Not Supporting | | |

Phytopiankton and Algai Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of alga may discolor the water or form visible mats on the water's surface. Blooms may be unsightly and deleterious to water quality causing fish kills, anoxia and taste and odor problems.

An algal sample with a biovolume larger than 5,000 mm³/m³, a density greater than 10,000 units/ml or a chlorophyll a concentration approaching or exceeding 40 µg/l (the NC State standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms associated fish kills or interference with recreation or water supply uses are all considered.

↑ CHEMICAL/PHYSICAL DATA

Chemical/physical water quality data is collected through the state's Ambient Monitoring System. This data is downloaded from the Surface Water Information Management System (ambient database) to a desktop computer for analysis. Total number of samples and percent exceedences of state standards are used for use support ratings. It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions. These natural conditions do not constitute a violation of water quality standards.

Data for copper, iron and zinc are not used according to the percent excess scheme outlined above. Because these metals are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility and stream characteristics, they have *action level* standards.

In order for an action level standard to be violated, there must be a toxicological test that documents an impact on a sensitive aquatic organism. The action level standard is used to screen waters for potential problems with copper, iron and zinc.

Best professional judgment is used to determine which streams have metal concentrations at potentially problematic levels. Streams with high metal concentrations are evaluated for toxicity, and they may be rated as PS or NS if toxicity tests or biomonitoring (e.g., benthic macroinvertebrate communities) indicate problematic metal levels.

Fecal coliform bacteria data is not used alone to determine a PS or NS rating. The geometric mean is calculated using monthly samples, and if the geometric mean is above



Waters with shellfish growing areas are classified as:

- Approved Area an area determined suitable for the harvesting of shellfish for direct market purposes.
- Conditionally
 Approved Open waters that are
 normally open to
 shellfish harvesting
 but are closed on a
 temporary basis in
 accordance with
 management plan
 criteria.
- Conditionally
 Approved Closed waters that are
 normally closed to
 shellfish harvesting
 but are open on a
 temporary basis in
 accordance with
 management plan
 criteria.
- Restricted Area
 an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- Prohibited Area an area unsuitable for the harvesting of shellfish for direct market purposes.

200 colonies/100 ml, fecal coliform bacteria are listed as a problem parameter. Because North Carolina's fecal coliform bacteria standard is 200 colonies per 100 ml for the geometric mean of five samples taken in a thirty-day period, fecal coliform bacteria are listed as a cause of impairment for the 303(d) list only when the standard is exceeded.

↑ SOURCES AND CAUSE DATA

In addition to the previously described data, existing information is documented for potential sources and causes of stream degradation. It is important to note that not all impaired water bodies have sources and/or causes listed for them. Additionally, fully supporting waterbodies have sources and/or causes of stream degradation as well. Staff and resource limitations do not currently allow this level of information to be collected for all waterbodies. Much of this information is obtained through the cooperation of federal, state and local agencies, other organizations and citizens.

Point Source Data

Whole Effluent Toxicity Data

Many facilities are required to monitor whole effluent toxicity by their NPDES permit or administrative letter. Streams that receive a discharge from a facility that has failed its whole effluent toxicity tests may have that facility listed as a potential source of pollution.

Daily Monitoring Reports
Streams that receive a discharge from a facility significantly out of

compliance with permit limits may have that facility listed as a potential source of pollution.

Nonpoint Source Data

Nonpoint sources of pollution (i.e., agricultural, urban and construction) are identified by monitoring staff, other agencies (federal, state and local), land use reviews and public workshops.

Problem Parameters

Causes of stream degradation (problem parameters), such as habitat degradation and low dissolved oxygen, are also identified for specific stream segments where possible. For streams with ambient water quality stations, the parameters that exceed the water quality standard ≥ 11 percent of the time during the review period are listed as a problem parameter.

Zinc, copper and iron are listed as problem parameters if levels are high enough to impact the biological community (see *Chemical/Physical Data* section). Fecal coliform bacteria are listed as a problem parameter if the geometric mean is greater than 200 colonies/100 ml. For segments without ambient stations, information from reports, other agencies and monitoring staff is used when available.

Habitat degradation is identified when there is a notable reduction in habitat diversity or change in habitat quality. The term includes sedimentation, bank erosion, channelization, streambed scour, lack of riparian vegetation, loss of pools or riffles, and loss of woody habitat.



↑ OUTSIDE DATA

DWQ actively solicits outside data and information. Data from outside DWQ, such as USGS ambient monitoring data, volunteer monitoring data and data from academic researchers, is screened for data quality and quantity. If data is of sufficient quality and quantity, it is incorporated into use support assessments.

A minimum of ten samples over a period of two years is needed to be considered for use support assessments. The way the data is used depends on the degree of quality assurance and quality control of the collection and analysis of the data. High quality data is used in the same fashion as DWQ data to determine use support ratings. Lower quality data may be used to pinpoint causes of pollution and problem parameters. Data may also be used to limit the extrapolation of use support ratings up or down a stream from a DWQ monitoring location. When outside data indicates a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations and makes adjustments as necessary.

↑ MONITORED VS. EVALUATED

Assessments are made on either a monitored (M) or evaluated (E) basis, depending on the level of information that is available.

Streams are rated on a monitored basis if data is less than five years old. Because a monitored rating is based on more recent and sitespecific data, it is treated with more confidence than an evaluated rating.

Streams are rated on an evaluated basis under the following conditions:

Overall Basis - Monitored

Specific Basis:

Monitored (M)

Monitored/ Evaluated (ME)

 Monitored stream segments with data
 ≤5 years old. * Stream segment is unmonitored, but is assigned a use support rating based on another segment of same stream for which data ≤5 years old is available. *

Overall Basis - Evaluated

Specific Basis:

Evaluated (E)

Evaluated/ Old Data (ED)

 Unmonitored streams that are direct or indirect tributaries to monitored stream segments rated FS. Must share similar land use to the monitored stream segment. Monitored stream segments with available data >5 years old. *

Overall Basis - Not Rated

Specific Basis - Not Rated

- No data available to determine use support. Includes unmonitored streams that are direct or indirect tributaries to stream segments rated PS or NS.
- * A stream segment is a stream, or a portion thereof, listed in the Classifications and Water Quality Standards for a river basin. Each segment is assigned a unique identification number (index number).

Major data sources include benthic macroinvertebrate bioclassifications, fish community structure (NCIBI), and chemical/physical monitoring data.

From the year that basin monitoring was done.



ASSIGNING USE SUPPORT RATINGS TO FRESHWATER STREAMS

At the beginning of each assessment, subbasin data is reviewed with monitoring staff. Discrepancies between data sources are resolved during this phase of the process. For example, a stream may be sampled for both benthic and fish community structure, with the benthic bioclassification differing from the NCIBI (i.e., the bioclassification may be FS while the NCIBI may be NS). To resolve this, the final rating may defer to one of the samples (resulting in either FS or NS), or it may be a compromise between both of the samples (resulting in PS).

After reviewing the existing data, use support ratings are assigned to the streams. If one data source exists for the stream, the rating is assigned based on the translation of the data value. If more than one source of data exists for a stream, the rating is assigned according to the following hierarchy:

- Benthic Bioclassification/ Fish Community Structure
- 2. Chemical/Physical Data
- 3. Monitored Data >5 years old
- 4. Compliance/Toxicity Data

This is only a general guideline for assigning use support ratings and is not meant to be restrictive. DWQ reviews each segment individually, and the resulting rating may vary from this process based on a best professional judgment that considers site-specific conditions.

After ratings are assigned to streams with existing data, streams with no existing data are assessed. Streams that are direct or indirect tributaries to streams rated FS receive the same rating (with an evaluated basis) if they have no known significant impacts, based on a review of the watershed characteristics and discharge information. Streams that are direct or indirect tributaries to streams rated PS or NS, or that have no data, are assigned NR.

ASSESSMENT METHODOLOGY - LAKES

North Carolina has approximately 1500 lakes (waterbodies defined as natural lakes or impoundments greater than 10 acres in surface area that are not tidally influenced).

The state's only natural lakes, mostly Carolina Bay Lakes, all occur in the coastal plain. The remaining lakes range from small ponds to large, multi-purpose reservoirs.

There are approximately 160 "significant" lakes in North Carolina that encompass 311,071 acres. Lakes are considered significant if they fall into one or more of the following categories:

- 1. Are greater than 100 acres in surface area and are publicly accessible.
- 2. Are classified as drinking water supplies.
- 3. Have had water quality assessments performed by DWQ.

The complex and dynamic ecosystem interactions that link chemical and physical water quality

parameters and biological response variables must be considered when evaluating use support.

In general, North Carolina assesses use support by determining a lake's intended uses (water supply, fishing and recreation). Violations of water quality standards are not equated with use impairment unless uses are not available. In following this approach, use support for agriculture, aquatic life propagation, maintenance of biological integrity, wildlife, recreation and water supply can be holistically evaluated.

Nutrient enrichment, or eutrophication, is one of the main causes of lake impairment. Several water quality variables including pH, chlorophyll *a*, dissolved oxygen, phosphorus, nitrogen, turbidity, total dissolved gases and other quantitative indicators are used to help describe the level of eutrophication. Some of these variables are already specific water quality standards.

It is generally agreed that excessive amounts of nitrogen and phosphorus are the principal culprits in eutrophication-related use impairment. While these variables are important concerns, climate, hydrology and biological response factors such as chlorophyll, phytoplankton and fish kills must also be evaluated because they can control the frequency of episodes related to potential use impairment. In addition, many of North Carolina's lakes are human-made reservoirs that do not mimic natural systems.

ASSESSMENT METHODOLOGY SALTWATER BODIES

Estuarine waters are delineated according to Division of Environmental Health (DEH) shellfish management areas for use support assessment. As with the freshwater assessments, many types of information are used to determine use support ratings and to determine causes and sources of use support impairment for saltwater bodies. The following data sources are used when assessing estuarine areas.

→ DEH SANITARY SURVEYS

DEH is required to classify all shellfish growing areas based on their suitability for shellfish harvesting. Growing areas are continuously sampled and reevaluated every three years to determine if their classification is still applicable. Classifications are based on fecal coliform bacteria sampling, locations of pollution sources and the availability of the shellfish resource.

← CHEMICAL/PHYSICAL DATA

Chemical/physical water quality data are collected monthly through the Ambient Monitoring System. The total number of samples and percent exceedences of the NC State standards are used for use support ratings. Parameters are evaluated based on the salt waterbody classification and corresponding water quality standards.

Fecal coliform bacteria data from DWQ ambient monitoring are considered for SB and SC waters



(saltwaters not classified by DWQ for shellfishing), but are not used alone to determine a partially or not supporting rating.

↑ PHYTOPLANKTON AND ALGAL BLOOM DATA

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mates on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia or odor problems.

An algal sample with a biovolume larger than 5000 mm³/m³, density greater than 10,000 units/ml or chlorophyll *a* concentrations approaching or exceeding 40 *ug*/l (the NC standard) constitutes a bloom.

Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters.

The frequency, duration, spatial extent, severity of blooms, associated fish kills, or interference with recreation or water supply uses are all considered.

ASSIGNING SALTWATER USE SUPPORT RATINGS

Saltwaters are classified according to their best use. When assigning a use support rating, the waterbody's assigned classification is used with the above parameters to make a determination of use support.

It is important to note that DEH classifies all actual and *potential* growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting, but different DWQ use classifications may be assigned to separate segments within DEH management areas.

In determining use support, the DEH classifications and management strategies are only applicable to those areas that DWQ has classified as SA (shellfish harvest waters). This will result in a difference of acreage between DEH areas classified as conditionally approved-closed, prohibited or restricted and DWQ waterbodies rated as PS or NS.

For example, if DEH classifies a 20-acre waterbody as prohibited, but only 10 acres have a DWQ use classification of SA, only those 10 acres classified as SA will be rated as partially supporting their uses based on DEH information. DWQ areas classified as SB and SC are rated using chemical/physical data, phytoplankton data, and algal bloom and fish kill data.

REVISIONS TO METHODOLOGY SINCE 1992-93 305(b) REPORT

Three significant changes to use support methodology have been made since the 1992-1993 305(b) report pertaining to the use of older information and fish consumption advisories.



- Methodology for determining use support has been revised to accurately reflect water quality conditions. In the 1992-1993 305(b) report, information from older reports and workshops was included in making use support determinations. Streams assessed using this information were rated on an evaluated basis because reports were considered outdated and workshops relied on best professional judgment since actual monitoring data was not available.
 - In place of these older reports and workshop information, DWQ is now relying more heavily on data from its expanded monitoring network. These changes resulted in a reduction in streams rated on an evaluated basis. The basinwide process allows more resources to be concentrated on individual basins during the monitoring phase.
- The rating fully supporting but threatened (ST) is no longer used. Instead, three categories are now used including fully supporting (FS), partially supporting (PS) and not supporting (NS). Waters that are fully supporting but have some notable water quality problems are discussed in the subbasin chapters of the basinwide plans.
- Mercury levels in surface waters are primarily related to increases in atmospheric mercury deposition from global/regional sources, rather than from local surface water discharges. As a result, fish consumption advisories due to mercury have been posted in many areas (primarily coastal areas) of the state.

Waters with fish consumption advisories related to mercury and dioxin are no longer considered for use support determination. However, these waters will continue to appear on the 303(d) list, and management strategies will be developed for these waters as required by the Clean Water Act.

303(d) LISTING AND REPORTING REQUIREMENTS

◆ WHAT IS THE 303(d) LIST?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will improve water quality to the point that standards or uses are being met.

Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters.

↑ 303(d) LIST DEVELOPMENT

The development of North Carolina's 303(d) list involves four basic steps: 1) gathering information about the quality of North Carolina's waters; 2) screening those waters to determine if any are impaired and should be listed; 3) determining if a total maximum daily load (TMDL) has been developed; and 4) prioritizing impaired waters for TMDL development.

Sources of Information

For North Carolina, the primary sources of information are basinwide management plans, 305(b) reports and accompanying assessment documents, all of which are prepared on five-year cycles.

Basinwide management plans include information concerning permitting, monitoring, modeling and nonpoint source assessment by basin for each of the 17 major river basins within the state. Basinwide management allows the state to examine each river basin in detail and to determine the interaction between upstream and downstream, point and nonpoint pollution sources.



As such, more effective management strategies can be developed across the state.

№ FOR MORE INFORMATION...

More information on North Carolina's Use Support Ratings is contained in *North Carolina's 2000 303(d) List* which is available online at http://h2o.enr.state.nc.us/mtu/download.html or by contacting the DWQ Planning Branch at (919) 733-5083.

C-6 POINT SOURCE PROGRAMS



NPDES WASTEWATER DISCHARGE PERMITS

All wastewater discharges to surface waters in the State of North Carolina must receive a permit to control water pollution. The Clean Water Act of 1972 initiated strict control of wastewater discharges with responsibility of enforcement given to the Environmental Protection Agency (EPA). The EPA then created the National Pollutant Discharge Elimination System (NPDES) to track and control point sources of pollution.

The primary method of control is the issuance of discharge permits with limitations on wastewater flow and constituents. The EPA delegated permitting authority to the State of North Carolina in 1975.

The NPDES Unit is responsible for issuing wastewater discharge permits. The issuance process includes determining the quality and quantity of treated wastewater the receiving stream is capable of assimilating, incorporating input from modeling, Regional Office staff, and the location of the discharge.

Where appropriate the NPDES program establishes limits for flow (quantity discharged), conventional pollutants (BOD, pH, TSS, fecal coliform, oil & grease, etc.), toxicants (metals, volatile organics, etc.), and non-conventional pollutants such as ammonia and

nutrients. Delegated states have the authority to establish state water quality standards more stringent than federal standards established by EPA.

North Carolina has a comprehensive National Pollutant Discharge Elimination System (NPDES) program that includes the following major components:

- 1. NPDES Permit Review and Processing
- 2. Wasteload Allocation Modeling
- 3. Compliance Monitoring and Enforcement
- 4. Aquatic Toxicity Testing
- 5. Pretreatment
- 6. Operator Certification and Training
- Non-Discharge and Regional Wastewater Treatment Alternatives

↑ NPDES PERMIT REVIEW AND PROCESSING

In North Carolina, the issuance of discharge permits is coordinated with the basinwide planning process. This allows DWQ to issue all discharge permits within a given basin at approximately the same time.

NPDES permits are valid for five years with new discharge permits issued during an interim basinwide planning period having a shorter expiration period so they will coincide with the next basin permitting cycle. DWQ can now effectively monitor and modify its permitting system consistently across river basins.

NPDES permits are issued in two categories: individual and general. Individual permits, which are issued



to specific facilities, contain sitespecific requirements that incorporate recommendations from the basinwide water quality management plan in which the facility is located. Individual NPDES permits are typically valid for fiveyears with all permits in a river basin set to expire during the same period. This strategy allows for a comprehensive review of individual dischargers within a basin, and provides for the implementation of basinwide water quality management plan recommendations.

General permits are developed for a general type of industry and contain permit requirements that are appropriate for a typical facility within a specific industrial classification. Facilities engaged in a specific industrial activity are eligible for permit coverage under the general permit. Facilities that are deemed to be atypical, or have a history of water quality problems, are required to obtain an individual permit.

Because general permits are specific to a type of industrial activity and are issued statewide, they do not contain basin-specific measures. A general permit is typically issued for a five-year cycle, with all permits set to expire on the same date.

↑ WASTELOAD ALLOCATION MODELING

In order to assess the impacts of pollutants on surface water quality, DWQ develops and applies water quality models. A water quality model is a simplified representation of the physical, chemical and

biological processes that occur in a waterbody.

The type of model that is used is dependent upon the purpose for which it is needed, the amount of information that is available or attainable for its development and the degree of accuracy or reliability that is warranted. In most cases, DWQ develops and applies a given model to predict the response of a natural system to a given set of inputs that reflect various management strategies.

For example, water quality models such as QUAL2E and DWQ's Level B model are used to predict instream dissolved oxygen concentration under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by DWQ.

A PRETREATMENT PROGRAM

The goal of the pretreatment program is to protect municipal treatment plants and publicly owned treatment works (POTWs), as well as the environment, from receiving hazardous or toxic wastes. The pretreatment program regulates nondomestic (industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA).

In essence, the program requires businesses and other entities that use or produce toxic wastes to pretreat their wastes prior to discharging wastewater into the sewage collection system of a POTW. State-



approved pretreatment programs are typically administered by local governments that operate POTWs.

Local pretreatment programs address four areas of concern: 1) interference with POTW operations; 2) pass-through of pollutants to a receiving stream; 3) municipal sludge contamination; and 4) exposure of workers to chemical hazards. Interference refers to a problem with plant operation including physical obstruction and inhibition of biological activity.

DWQ and local governments develop pretreatment limits by determining the maximum amount of each pollutant that a facility can accept at the influent (or headworks) while still protecting the receiving water, the POTW and the POTW's sludge disposal options.

◆ OPERATOR CERTIFICATION AND TRAINING

Water pollution control systems must be operated by individuals certified by the North Carolina Water Pollution Control System Operators Certification Commission (WPCSOCC). The level of training and certification that the operator must have is based on the type and complexity of the wastewater treatment system.

The Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, subsurface operation, spray irrigation operation, animal waste management and a variety of specialized conditional exams for specific

technologies (e.g., oil/water separators).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most efficient treatment system will not function properly. The goal of the WPCSOCC is to train competent and conscientious professionals who will provide the best wastewater treatment, and thus protect the environment and public health.

The Technical Assistance and Certification Unit of DWQ provides staff support to the Commission and assists in organizing operator training. Specialty courses and seminars for operators are also offered by the North Carolina combined section of the Water Environment Association/American Water Works Association (WEA/AWWA).

NON-DISCHARGE AND REGIONAL WASTEWATER TREATMENT ALTERNATIVES

DWQ requires NPDES permit applications to contain an analysis that considers alternatives to direct discharges to a receiving stream. This analysis includes a feasibility study on options such as the connection to a regional wastewater treatment facility or the use of non-discharge options such as spray irrigation, rapid infiltration basins and trickling systems. It also takes into consideration the economical feasibility of the options available.



If no other economically feasible option for wastewater disposal is available, the NPDES application will be forwarded for review and completion. If one or more alternative options are economically feasible, however, it must be reevaluated to determine which option is the best option.

Non-discharge is the preferred wastewater disposal alternative in most instances. Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that does not produce ponding or runoff.

← FOR MORE INFORMATION...

More information on North Carolina's National Pollutant Discharge Elimination System is available online at http://h2o.enr.state.nc.us/NPDES/NPDESweb.htm or by contacting DWQ's NPDES Unit at 919-733-5083.

C-7 UNIFIED WATERSHED ASSESSMENT



The Action Plan builds on the solid foundation of existing clean water programs and proposes new actions to strengthen efforts to restore and protect water resources.

agencies and the public to prepare an

aggressive Clean Water Action Plan

clean, safe water for all Americans.

(CWAP) to meet the promise of

The CWAP calls for each state to use four tools for clean water. They are:

- 1. A Watershed Approach
- 2. Strong Federal and State Standards
- 3. Natural Resource Stewardship
- 4. Informed Citizens and Officials

The Watershed Approach involves developing a Unified Watershed Approach (UWA) and Watershed **Restoration Action Strategies** (WRASs).

During September 1998, DWQ and **USDA-Natural Resource** Conservation Service (NRCS) staff convened to develop NC's UWA Detailed Report. Categorization and prioritization were performed based on analysis at the 8-digit HUA as directed by EPA. The state's WRAS was finalized in February 2000.

meeting, clean water and other natural resource goals.

- · Category II Watersheds Meeting Goals, **Including Those Needing Action to** Sustain Water Quality. These watersheds meet clean water and other natural resource goals and standards and support healthy aquatic systems.
- Category III Watersheds with Pristine or **Sensitive Aquatic System Conditions on** Lands Administered by Federal, State and Tribal Governments.
- Category IV Watersheds with Insufficient Data to Make an Assessment.

As part of the FY99 Section 319 grant, additional funds totaling \$2.4 million were granted to NC for BMP implementation in Category I watersheds. The EPA recommends that states target most Section 319 Incremental funding made available through the President's FY 1999 Clean Water and Watershed Restoration Budget Initiative, toward restoring these Category I watersheds.

North Carolina's UWA detailed report is available online at http://h2o.enr.state.nc.us/nps/ uwalong.pdf. The EPA Clean Water Action Plan is available online at http://www.epa.gov/cleanwater.





C-8 ALBEMARLE-PAMLICO NATIONAL ESTUARY PROGRAM



By authority of the Clean Water Act, the Governor of North Carolina and the US Environmental Protection Agency (USEPA) designated the Albemarle-Pamlico estuarine system as an "estuary of national significance" because of its natural and cultural heritage, economic value, species diversity and importance to the state's and country's natural resources. The area was among the first to be included in the EPA's National Estuary Program (NEP) in 1987.

Along with North Carolina's inclusion in the National Estuary Program came the responsibility of protecting local, state and national interests in maintaining the ecological integrity of the country's second largest estuarine system. Through a cooperative agreement between the NC Department of **Environment and Natural Resources** (DENR) and US EPA, the Albemarle-Pamlico Estuarine Study (APES) was created to study environmental conditions in a 23,000 mi² watershed that included much of northeast North Carolina and parts of southeastern Virginia.

From 1987 through 1994, APES provided extensive information and scientific research about the environmental issues facing the Albemarle-Pamlico region. Through an extraordinary collaborative effort, government agencies, stakeholder groups and citizens were able to

transform this scientific information into a Comprehensive Conservation and Management Plan (CCMP) that proposes management strategies designed to protect the region's natural resources while allowing for responsible economic growth. The CCMP was officially endorsed by Governor Hunt and the US EPA in November 1994.

During this period, APES was guided by a 95-member Management Conference that was composed of a Policy Committee, Technical Committee, Albemarle Citizens **Advisory Committee and Pamlico** Citizens Advisory Committee. These committees were comprised of members who represented a variety of interests including government agencies, university researchers, stakeholder groups and the public. Committees were responsible for identifying problems in the estuarine system, generating research where gaps in knowledge existed, increasing public awareness of environmental issues and identifying solutions to address those issues. Because of their efforts, more is known about the Albemarle-Pamlico estuary than ever before.

The major components of the NEP are the consideration of water quality, fisheries resources, land and water habitats and the interaction of humans with the natural resources of the estuarine system. This holistic approach not only shaped the

research and public involvement phases of the Albemarle-Pamlico Estuarine Study, it was also employed during development of the CCMP and is currently reflected in DWQ's basinwide water quality management strategy.

Now known as the Albemarle-Pamlico National Estuary Program, the APNEP coordinates public and private efforts that seek to protect, preserve, enhance and restore the natural, cultural and economic resources of the APNEP region.

With annual funding provided by the US EPA and DENR, the APNEP oversees the activities of five river basin Regional Councils (one in each river basin in the APNEP region) and is guiding implementation of seven Regional Council projects designed to demonstrate effective and

innovative resource management techniques and strategies.

In addition, the APNEP hosts a bienniel conference that focuses on the status and quality of environmental resources in the APNEP region, supports a Citizens Water Quality Monitoring Program based at East Carolina University, provides public outreach and environmental education to various stakeholder groups, works to expand programs that facilitate restoration and acquisition of critical riparian areas and participates in local, regional and national forums dedicated to the promotion of environmental stewardship.

◆ FOR MORE INFORMATION...

More information on the APNEP is available online at http://h2o.enr.state.nc.us/nep/ or by contacting DWQ at 919-733-5083.

C-9 WETLANDS RESTORATION PROGRAM



The North Carolina Wetlands
Restoration Program (NCWRP) is a
non-regulatory program responsible
for implementing wetland and stream
restoration projects throughout the
state. The focus of the program is to
improve water quality, flood
prevention, fisheries, wildlife habitat
and recreational opportunities.
Although it is not a grant program,
the NCWRP funds wetland, stream
and streamside (riparian) area
projects directly through the
Wetlands Restoration Fund.

The NCWRP has developed
Basinwide Wetlands and Riparian
Restoration Plans for each of the
state's seventeen river basins.
Basinwide Restoration Plans are
watershed-based strategies that
identify degraded or functioning
wetland and riparian areas which,
when restored or protected, could
significantly contribute to meeting
the needs of protecting and
enhancing water quality, fisheries,
wildlife habitat, flood prevention and
enhancement of recreational
opportunities in that watershed.

The NCWRP has identified sixty priority subbasins, within all the river basins, according to comparative size, water quality, overall ecological condition, availability and distribution of good restoration sites and the need for restoration within each river basin. The selection of priority subbasins was based primarily on water quality data from DWQ's Basinwide Water Quality Plans (this data is available

in geographic information system format and is contained in the Basinwide Wetlands and Riparian Restoration Plans).

Some data is also based on the 14-digit hydrologic unit level for Hydrologic Units targeted by the NCWRP. For example, the percentage of not supporting and partially supporting stream miles in each hydrologic unit is reported.

This information, along with other natural resource data relating to Natural Heritage Program sites and land use trends, is being used to target specific potential restoration sites and to identify landowners whose properties could provide significant public benefits through NCWRP restoration efforts.

The water quality information found in the Basinwide Water Quality Plans was used by NCWRP as a primary tool for prioritizing NCWRP restoration efforts. In turn, the restoration work resulting from the Basinwide Wetlands and Riparian Restoration Plans will serve as a tool for achieving the water quality and aquatic habitat protection and enhancement goals that have been set forth in the Basinwide Water Quality Plans.

The NCWRP performs cooperative restoration projects with other state or federal programs or environmental groups. For example, NCWRP's efforts can complement projects funded through the Section 319

Some of the resource data layers that were compiled and analyzed in the targeting of hydrologic units included:

- shellfish closure areas;
- water supply watersheds;
- fin fish and shellfish nursery areas; and
- land use/land cover.



Program, thereby improving the overall water quality benefits of a project.

№ FOR MORE INFORMATION...

More information on the Wetlands Restoration Program is available online at http://h2o.enr.state.nc.us/ wrp/index.htm or by calling 919-733-5208.

Section D: Federal and Other State Water Quality Management Programs

D-1 FEDERAL PROGRAMS



US FOREST SERVICE

As the largest forestry research organization in the world, the US Forest Service provides technical and financial assistance to state and private forestry agencies and manages public lands in national forests and grasslands.

The mission of the Forest Service is, "to provide the greatest amount of good for the greatest amount of people in the long run." Their mission, "Caring for the Land and Serving People" is accomplished through five primary activities:

- 1. Protection and management of natural resources on National Forest System lands.
- 2. Research on all aspects of forestry, rangeland management and forest resource utilization.
- Community assistance and cooperation with state and local governments, forest industries and private landowners to help protect and manage nonfederal forest and associated range and watershed lands to improve conditions in rural areas.
- 4. Achieving and supporting an effective workhorse that reflects the full range of diversity of the American people.
- International assistance in formulating policy and coordinating US support for the protection and sound management of the world's forest resources.

↑ FOR MORE INFORMATION...

...check out the US Forest Service web site at http://www.fs.fed.us/

US FISH AND WILDLIFE SERVICE

The mission of the US Fish and Wildlife Service (USFWS) is to conserve, protect and enhance fish and wildlife and their habitats for the continuing benefit of the American people. The major responsibilities of the service include migratory birds, endangered species, certain marine mammals and freshwater and anadromous fish.

The USFWS reaches out to form new partnerships with farmers and ranchers, state and federal agencies, Native American Tribes, corporations, conservation groups and citizen volunteers.

Through a collaborative approach, the country's important remaining wildlife habitats (many of which are privately owned) can be conserved, and the nation's rich abundance of fish and wildlife species can be maintained.

№ FOR MORE INFORMATION...

...visit the USFWS web site at www.fws.gov. The Southeast Region 4 web site is located at http://southeast.fws.gov/ and the North Carolina field office is at http://southeast.fws.gov/maps/nc.html

US ARMY CORPS OF ENGINEERS

The Corps of Engineers provides comprehensive engineering, management and technical support to the Department of Defense, other federal agencies and to state and local governments. The agency defends America's security - militarily, economically and environmentally - and is responsible for such water quality protection efforts as:

- Planning, design, building and often operating and maintaining projects that provide river and harbor navigation, flood control, water supply, hydroelectric power, environmental restoration, wildlife protection and recreation.
- Protecting the nation's waterways and wetlands.
- Putting to work the nation's engineering, contracting and construction management skills for other federal agencies on missions ranging from toxic waste cleanup for the Environmental Protection Agency's "Superfund" program to construction of space facilities for NASA.
- Developing engineering software for flood control planning, groundwater analysis and water control data.
- Providing information and support for state and local governments.

← FOR MORE INFORMATION...

...visit the US Army Corps of Engineers web site at http://www.usace.army.mil/ or the Wilmington District site at http://www.saw.usace.army.mil/domino/CESAW.nsf

US DEPARTMENT OF AGRICULTURE NRCS

The USDA Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service, is the lead federal conservation agency working to conserve natural resources on private lands. The NRCS was created in the mid 1930s as a national response to the Dust Bowl catastrophe, and after more than 7 decades, is still looking after the health and well being of America's land, water, air, plants and animals.

The NRCS relies on partners such as conservation districts, state and federal agencies, NRCS Earth Team volunteers, agricultural and environmental groups and professional societies to help set conservation goals and provide assistance.

♣ FOOD SECURITY ACT OF 1985 (FSA) AND THE FOOD, AGRICULTURE, CONSERVATION AND TRADE ACT OF 1990 (FACTA)

Several provisions authorized by the federal Food Security Act of 1985 (FSA) and reauthorized by the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA) offer excellent opportunities for the abatement of agricultural nonpoint source pollution.

Both the FSA and FACTA make the goals of the USDA farm and



conservation programs more consistent by encouraging a reduction in soil erosion and the production of surplus commodities, as well as the retention of wetlands. These programs benefit different types of agricultural operations, protect sensitive environments and provide economic benefits to landowners. Highlights of these programs include:

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) provides technical, educational and financial assistance to concerned landowners interested in utilizing soil, water and natural resource controls on their property. EQIP assists farmers in implementing structural, vegetative and land management practices through 5-10 year contracts on eligible land.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is administered by the NRCS in conjunction with USDA, NC Cooperative Extension Service, NC Division of Forest Resources and local Soil and Water Conservation Districts. The CRP was established to encourage the removal of highly erodible land from crop production and to promote the long-term planting of permanent grasses and tree cover through cost sharing.

The intention of the program is to protect the long-term ability of the US to produce food and fiber by reducing soil erosion, improving water quality and improving habitat for fish and wildlife. Additional objectives are to curb the production of surplus commodities and to

provide farmers with income supports through rental payments over a 10-year contract period for land entered under the CRP.

Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP) is a joint, state-federal land retirement conservation program targeted to address state and nationally significant agriculture-related environmental effects. This voluntary program uses financial incentives to encourage farmers and ranchers to enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production.

The two primary objectives of CREP are 1) to coordinate Federal and non-federal resources to address specific conservation objectives of a State and the nation in a cost-effective manner, and 2) to improve water quality, erosion control and wildlife habitat related to agricultural use in specific geographic areas.

There are four important ways in which CREP differs from the CRP. First, CREP is targeted to specific geographic areas. It is designed to focus conservation practices that address specific environmental concerns of a high priority. Second, CREP is a joint undertaking among states, the federal government and other stakeholders who have an interest in addressing particular environmental issues. Third, it is results-oriented and requires states to establish measurable objectives and conduct annual monitoring to measure progress toward implementation of those objectives.



Fourth, it is flexible, within existing legal constraints, and can be adapted to meet local conditions on the ground.

In North Carolina, CREP will help protect the Albemarle-Pamlico Estuarine System from the effects of excessive nutrient and sediment loading due to agricultural runoff. The State of North Carolina and the US Environmental Protection Agency (EPA) targeted this region for protection as signs of environmental stress became increasingly evident in the area. The program is targeted primarily at the Neuse, Tar-Pamlico and Chowan river basins, as well as the Jordan Lake watershed.

The objectives of CREP in North Carolina include:

- Helping agricultural producers meet mandatory nutrient reduction goals in the Neuse and Tar-Pamlico river basins as well as promoting voluntary nutrient reduction strategies in the Chowan and Jordan Lake Watersheds.
- Improving primary nursery areas and sensitive anadromous fishery habitats by controlling excessive freshwater flows through wetland restoration.
- Enhanced habitat for rare or declining wildlife resources.
- Improved spawning habitat for several commercially important fish species.

North Carolina will conduct monitoring throughout the project duration to evaluate and record progress in achieving these goals.

The federal government will pay 50 percent of the cost of installing conservation practices such as

installing new vegetation, fencing, etc.

For producers who enroll solely in a 15-year CREP contract, the state will pay 25 percent of the cost of establishing trees, 20 percent of the approved costs of livestock exclusion and remote watering and 10 percent of the costs of installing grassed filter strips.

Participants will receive \$5 per acre for annual maintenance regardless of the conservation practice installed. Producers who also enroll in NC CREP permanent or 15-year conservation agreements, North Carolina will provide a one-time bonus payment. Regardless of the type or length of CREP agreement, lands enrolled in trees will receive \$100 bonus payment per contract.

When fully implemented, this CREP is expected to substantially reduce nitrogen and sediment contamination of Nutrient Sensitive Waters with significant water quality and wildlife habitat benefits.

Conservation Compliance

The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland when the land is not carefully protected from erosion. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to, or greater than, eight times the rate at which the soil can maintain continued productivity. This rate is determined by the Natural Resources Conservation Service.



Sodbuster

The Sodbuster provision of the FSA and FACTA is aimed at discouraging the conversion of highly erodible land for agricultural production. As with the other provisions of the FSA, the Natural Resources Conservation Service determines if a field is highly erodible. If a highly erodible field is planted in an agricultural commodity without an approved conservation system, the landowner (or farmer) becomes ineligible for certain USDA program benefits.

Swampbuster

The purpose of Swampbuster is to discourage the conversion of wetlands to cropland use. The Natural Resources Conservation Service determines if an area is a wetland. Like the other provisions of the FSA and FACTA, a farmer will lose eligibility for certain USDA program benefits on all the land that is farmed if a wetland area is converted to cropland.

Conservation Easement

The Conservation Easement provision encourages producers whose FHA loans are in, or near default, to place their wetlands, highly erodible lands and fragile lands in conservation, recreation or wildlife uses for periods of at least 50 years. The producer benefits by having the FHA loan partially canceled, while the environment benefits through a reduction in soil disturbance and agricultural pollution.

Wetland Reserve

FACTA established a voluntary program allowing farmers to grant

the federal government a 30-year, or perpetual, easement to wetlands. Eligible land includes farmed or converted wetlands that could be restored to their highest wetland function and value.

Water Quality Incentive Program

FACTA established this cost-sharing program to help farmers control pollution problems associated with agricultural activities. A producer could receive up to \$3,500 in cost-share assistance to implement approved BMPs.

Watershed Protection and Flood Prevention Program

The purpose of the Watershed Protection and Flood Prevention Program is to provide technical and financial assistance in planning, designing and installing improvement projects for protection and development of small watersheds. The program is administered by the NRCS in cooperation with the NC Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the US Forest Service, Soil and Water Conservation Districts and other project sponsors.

The emphasis of the program has been to provide flood control. Recent legislation, however, has shifted the emphasis to land treatment projects so that a project proposal must demonstrate off-site water quality benefits.

↑ FOR MORE INFORMATION...

...on any of these programs, visit the NRCS web site located at http://www.nrcs.usda.gov/





D-2 STATE PROGRAMS

The following state agencies are involved in the management and protection of water quality in North Carolina.

NC DIVISION OF SOIL AND WATER CONSERVATION

NORTH CAROLINA AGRICULTURE COST SHARE PROGRAM

The NC Agriculture Cost Share Program will pay a farmer 75 percent of the average cost of implementing approved BMPs and will offer technical assistance to landowners or users that would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

Local Soil and Water Conservation
District Boards, under the
administration of the North Carolina
Soil and Water Conservation
Commission (SWCC), are
responsible for identifying treatment
areas, allocating resources, signing
contractual agreements with
landowners, providing technical
assistance for the planning and
implementation of BMPs and
generally encouraging the use of
appropriate BMPs to protect water
quality.

The Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of associated program committees and acts as the clearinghouse for district strategy plans and contracts. A legislated Technical Review Committee meets quarterly to review the progress of the program and to make technical recommendations to the Commission.

Technical assistance for the implementation of approved BMPs is provided to the districts through a 50:50 cost share provision for technical positions to be filled at the district level. The USDA-Natural Resources Conservation Service also provides technical assistance.

← FOR MORE INFORMATION...

...visit the NC Division of Soil and Water Conservation web site at http://www.enr.state.nc.us/DSWC/

NC DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

NORTH CAROLINA PESTICIDE LAW OF 1971

The North Carolina Pesticide Board regulates the use, application, sale, disposal and registration of pesticides for the protection of the health, safety and welfare of the people, and for the promotion of a more secure, healthy and safe environment for all the people of the state.

The Pesticide Section is involved in enforcement through inspections and investigations. All commercial





storage facilities and pesticide applicators that store restricted-use pesticides must have an approved pre-fire plan and an annual inspection by a local fire department and/or emergency services office.

In addition, each commercial storage facility and pesticide applicator storing at least 10,000 pounds of restricted-use pesticides at any one time must have a board-approved contingency plan that describes the actions facility personnel will take in the event of fires, explosions, spills or any other sudden release of pesticides or pesticide contaminated materials to air, soil or surface water.

The Pesticide Section has been involved in a groundwater monitoring program to determine the impact of pesticides on this valuable resource. Additionally, the section has been conducting private domestic drinking water well surveys in order to protect human health and to find additional locations to study by installing new monitoring wells. Data will be used in the development of Pesticide Management Plans for the protection of groundwater resources as required by the USEPA.

In 1995, the Pesticide Section began using the Pesticide Environmental Trust Fund (PETF) to actively promote and implement voluntary pesticide pollution prevention and environmental stewardship initiatives aimed at providing added protection to human health and the environment. Since 1995, the section has used the fund to enable 78 counties to establish pesticide

container recycling programs for farmers and commercial applicators.

♠ SOIL, PLANT WASTE AND SOLUTION ADVISORY PROGRAMS

The Agronomic Division of the NC Department of Agriculture and Consumer Services provides analytical and advisory services to protect soil and water resources and improve agricultural productivity and efficiency. Soil testing and waste analyses are the basic tools needed to responsibly apply waste and other nutrient-bearing materials on agricultural land.

Soil testing determines fertility status and nutrient requirements. A waste analysis indicates usability of byproducts as nutrient sources and predicts nutrient availability. Plant analysis determines nutritional status of growing crops and the effectiveness of fertilizer programs in meeting crop requirements. Solution analysis indicates quality of surface and groundwater supplies and usability in agricultural production. Nematode assay determines the need for pesticides to reduce the impact of microscopic plant-parasitic worms on crop production.

Agronomic Division services can be effective in solving crop production problems and ensuring optimum yield, quality and efficiency. They are also critical in monitoring soil and water resources and environmental stewardship. Division field advisory services provide a staff of agronomists for site-specific implementation of recommendations



and assistance in crop production and waste utilization.

№ FOR MORE INFORMATION...

...visit the NC Department of Agriculture and Consumer Services web site at http://www.agr.state.nc.us/

NC DIVISION OF FOREST RESOURCES

№ FOREST PRACTICE GUIDELINES RELATED TO WATER QUALITY

Effective January 1, 1990, the Sedimentation Pollution Control Act (SPCA) was amended to require all forestry operations to comply with nine performance standards in order to remain exempt from the permitting requirements of the SPCA. These nine performance standards are listed in the *Forest Practice Guidelines Related to Water Ouality* (FPGs).

The FPGs, like the SPCA, are performance-based, which means that they require measures such as the establishment of a streamside management zone along intermittent and perennial streams and waterbodies to restrain accelerated erosion and to prevent visible sediment from entering intermittent and perennial streams and waterbodies.

The use of Best Management Practices (BMPs) is encouraged to meet the FPG requirements. A Forestry Best Management Practices Manual and other publications are available to provide guidance in meeting the FPGs. NC Division of Forest Resources (DFR) personnel work with landowners, timber buyers and loggers, when requested, to help plan and prevent water quality problems.

DFR monitors compliance with the FPGs under a memorandum of agreement with other agencies (MOAs). If a potential violation is found, DFR will attempt to have it corrected by the responsible party (ies) within a reasonable time frame. If not corrected, the project will be referred to the appropriate regulatory agency for enforcement action. In this case, the project is deemed out of compliance with the FPGs and subject to permitting requirements of the SPCA.

№ FOREST MANAGEMENT PROGRAM

One of the largest efforts by DFR is preparation of, and assistance in completing, Forest Management Plans for non-industrial private landowners. Many of these plans include recommendations for site-disturbing activities subject to the FPGs. In the written management plans, and in personal contacts, DFR stresses the need for using appropriate BMPs to protect water quality. Site-specific recommendations are made to assist in preventing future problems.

Training is also carried out for different groups. DFR is working to eliminate varying expectations from FPGs by training experienced and inexperienced field personnel. Training is offered to loggers, timber buyers and others through the



ProLogger Program and other workshops.

In the field, workshops are held so that various interested groups can look at "real life" situations. DFR also assists with industrial environmental audits by companies that are participants in the *Sustainable Forestry Initiative*TM.

№ FOREST STEWARDSHIP PROGRAM

The goal of the Forest Stewardship Program is to work in cooperation with other natural resource agencies to bring more forestland under management.

Forest Stewardship Plans identify four resource categories (timber, fisheries and wildlife habitat improvement, recreation and aesthetics and soil and water conservation) and are developed for landowners based on individual goals and objectives. A landowner must own at least 10 acres of woodland and agree to manage it to improve at least three of the four resources while maintaining the fourth in at least the same condition.

← FOR MORE INFORMATION...

...visit the North Carolina Division of Forest Resources web site at http://www.dfr.state.nc.us/

NC WILDLIFE RESOURCES COMMISSION

In 1947, the North Carolina Wildlife Resources Commission was established as a new department, separate from the Department of Conservation and Development, to regulate and manage the state's fish and wildlife, enforce the laws protecting them and educate North Carolina's citizens about wildlife needs.

Since its inception, the commission has introduced innovative programs - such as the 1996 turkey restoration program - many of which have been adopted by other states.

The mission of the North Carolina Wildlife Resources Commission is to manage the fish and wildlife resources of the state, not only for the present generation of North Carolina citizens, but for future generations as well.

№ FOR MORE INFORMATION...

...visit the North Carolina Wildlife Resources Commission web site at http://www.state.nc.us/Wildlife/

NC DIVISION OF LAND RESOURCES

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act (SPCA) which authorized the establishment of a sediment control program to regulate accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the NC Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion



control plans for all projects that disturb one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of BMPs that are used. The objectives of the erosion and sediment control program are: 1) to prevent off-site sedimentation damage and 2) to control velocities to the discharge point. If voluntary compliance with the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief.

Local sedimentation and erosion control programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

In 1971, the North Carolina General Assembly passed the Mining Act to ensure that the usefulness, productivity and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the Act to the Mining Program within the Land Quality Section of the NCDENR Division of Land Resources.

The Mining Program has four major areas of responsibility. First, the program requires submission and approval of a mining permit application prior to initiating land-disturbing activity if the mining operation is one (1) or more acres in surface area.

The mining permit application must have a reclamation plan for these operations. Second, the program conducts on-site inspections to determine compliance with the approved application, and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators.

▶ FOR MORE INFORMATION...

...visit the NC Division of Land Resources web site at http://www.dlr.enr.state.nc.us/dlr.htm

NC DIVISION OF WASTE MANAGEMENT

States are accorded a major role in solid waste management by the Resource Conservation and Recovery Act (RCRA). North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Waste Management (DWM) in the Department of Environment and Natural Resources is authorized as



the single state agency for the management of solid waste.

DWM is responsible for the development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, and provides technical assistance. DWM also investigates complaints, responds to emergencies, monitors groundwater quality at facilities, promotes the state's recycling effort, and closes nonconforming sites.

In 1991, the Solid Waste
Management Act was amended to
broaden the goal to reduce the solid
waste stream by 40 percent by June
30, 2001 through source reduction,
reuse, recycling and composting.
This Act created a Solid Waste
Management Trust Fund to promote
waste reduction, research and
demonstration projects to manage
solid waste.

The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. These rules also required all unlined municipal solid waste landfills close by January 1, 1998.

All permitted landfills currently receiving municipal solid waste in North Carolina are constructed with a liner and leachate collection system designed to protect groundwater from contamination. Septage rules

and regulations were adopted in March 1989 which include setback and land application rate requirements.

These rules are administered through a permit program. In 1989, the State Scrap Tire Act was enacted. In 1993, the state placed a two percent disposal fee on new tire sales. With these funds, over 5,400,000 scrap tires (>95% of total scrap tires) at over 250 sites have been cleaned up, eliminating the chance of groundwater contamination caused when tires burn, and when the fire is extinguished with water or chemical fire retardants.

In 1989, the Division began permitting both one-day Household Hazardous Waste (HHW) collection events and permanent HHW collection facilities. This program allows homeowners access to free disposal of HHW such as pesticides, paints, antifreeze, etc., diverting these chemicals from the municipal solid waste stream, and minimizing potential improper disposal by the homeowner and the resulting groundwater impact.

↑ LOCAL PROGRAM

Solid waste collection and disposal have long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321).

Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such



regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301).

Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities, and most disposal facilities in the state are now operated by counties or with county financial assistance.

№ FOR MORE INFORMATION...

...visit the NC Division of Waste Management web site at http://wastenot.enr.state.nc.us/

NC DIVISION OF ENVIRONMENTAL HEALTH

Soil absorption systems are the most widely used method of wastewater treatment and disposal in North Carolina. More than 52 percent of all housing units in the state are served by on-site wastewater systems.

A conventional septic system consists of a septic tank, a distribution box, and a series of subsurface absorption lines with perforated pipes laid in a bed of gravel. Advanced wastewater systems utilize pretreatment methods such as filters and aerobic treatment and utilize improved distribution systems such as pressure dosing on sensitive sites.

All subsurface wastewater treatment and disposal systems are under the jurisdiction of the Commission for Health Services (CHS). The CHS establishes the rules for on-site sewage systems that are administered by the Division of Environmental Health through local health departments.

The rules provide siting, design and construction requirements; standards for operation; and ownership requirements for each classification of sanitary systems of sewage collection, treatment and disposal in order to reduce or prevent any contamination of the land, groundwater and surface water.

Subsurface sewage discharging systems are governed by NCDENR through local county health departments. Authorized local environmental health specialists serve as agents of the Division and implement the state on-site wastewater laws.

The Wastewater Discharge Elimination (WaDE) Program was established in 1996 for the purpose of identifying and eliminating domestic sewage or wastewater discharges from both straight pipes and overland flow of failing septic systems.

The program contains three components: education, identification and public water supplies, and other surface waters.

The Division of Environmental Health and the Division of Water Quality have established an



agreement that provides 319(h) funding for one staff position in the On-Site Wastewater Section to coordinate and implement the NPS activities of the on-site program as part of the basinwide water quality management plans.

↑ FOR MORE INFORMATION...

...visit the NC Division of Environmental Health web site at http://www.deh.enr.state.nc.us/ Call 1-800-9-SEWAGE (toll free) for more information on WaDE.

NC DIVISION OF WATER RESOURCES

№ WATER SUPPLY PLANNING LAW

The Water Supply Planning law (G.S. 143-355 (l) and (m)) requires all units of local governments that provide or plan to provide public water services to prepare a local water supply plan. A local water supply plan is an assessment of water needs through the year 2020 and the ability to meet those needs. A specific plan that meets future water supply needs should be included. Plans must be adopted by the local governing board and submitted to the Division of Water Resources. The plans must be updated every five years or more frequently as information changes. In 1998, water systems should have updated their 1992 local water supply plans to reflect 1997 water supply and demand information.

The Division of Water Resources will use the information from the local plans, combined with other sources of water use information, to develop a Comprehensive State Water Supply Plan for North Carolina.

№ REGISTRATION OF WATERWITHDRAWALS AND TRANSFERS LAW

The Registration of Water Withdrawals and Transfers law (G.S. 143-215.22H) requires any person who withdraws or transfers a total of one million gallons of surface or groundwater per day or more to register with the Division of Water Resources.

Beginning in March 2000, this registration threshold will be lowered to 100,000 gallons per day for nonfarming water users. The registration includes average and maximum withdrawal and discharge amounts and location information.

The registration must be updated every five years. New withdrawals or transfers must be registered within 6 months of their start. Local governments with completed local water supply plans on file with the Division of Water Resources, in accordance with G.S. 143-355 (l), have satisfied this registration requirement. There is a one-time \$50 registration fee for each withdrawal facility that withdraws one million gallons per day (MGD) or more. Farming operations are exempt from registration fees.

In 1993, the legislature adopted the Regulation of Surface Water Transfers Act (G.S. 143-215.22I et seq.). This law was designed to



regulate large surface water transfers by requiring a certificate from the EMC and by repealing several other laws that had previously affected interbasin transfers.

The law applies to anyone initiating a transfer of 2 MGD from one river basin to another and to anyone increasing an existing transfer by 25 percent or more if the total transfer is 2 MGD or more. Applicants for certificates must petition the EMC and include a description of the transfer facilities, the proposed water uses, water conservation measures to assure efficient use and any other information desired by the EMC.

A certificate will be granted for the transfer if the commission concludes that the overall benefits of the transfer outweigh its detriments. The commission may grant the petition in whole or in part, or deny it, and it may require mitigation measures to minimize detrimental effects. The law also provides for a \$10,000 civil penalty for violating various statutes.

DWR administers the Capacity Use Act (G.S. 143-215.11 et seq.), which allows the EMC to establish a Capacity Use Area where it finds that the use of groundwater, surface water or both requires coordination and limited regulation. If after an investigation and public hearings a Capacity Use Area is designated, the EMC may adopt regulations within the area, including issuance of permits for water users.

In the near future, DWR plans to review the rules for implementation

of the Capacity Use statute and develop a model of the aquifer system, in coordination with the Groundwater Section of DWQ, for Capacity Use Area 1, which was created to regulate surface water and groundwater withdrawals in an area surrounding PCS Phosphate, Inc. in Aurora, NC. A new groundwater flow model will be used to simulate Capacity Use Area 1 as a basis for permitting withdrawals.

↑ DAM SAFETY LAW

The Dam Safety law (G.S. 143-215.24 through .31) defines "minimum streamflow" as a quantity and quality sufficient in the judgment of the Department of Environment and Natural Resources (DENR) to meet and maintain stream classifications and water quality standards established by DENR and to maintain aquatic habitat in the affected stream length.

The Dam Safety law applies to dams that are 15 feet or more high, and with impoundment capacity of 10-acre feet or more. Dams that do not meet both of these criteria are exempt from jurisdiction under this law unless their failure could result in loss of life or significant property damage. Federally owned and operated dams, as well as dams with federal hydropower licenses, are also exempt from this law.

Following amendments enacted by the 1993 General Assembly, rules were promulgated to determine the minimum flow needed to maintain aquatic habitat (15A North Carolina Administrative Code 2K.0501-.0504).



The approach used depends on the quality of aquatic habitat, size of stream and physiogeographic region of the state. Additional amendments were adopted by the 1995 General Assembly which specify the minimum flow for small hydropower producers that divert water around 4000 feet or less of the natural streambed.

№ FOR MORE INFORMATION...

...visit the NC Division of Water Resources web site at http://www.dwr.ehnr.state.nc.us/ home.htm

NC DIVISION OF COASTAL MANAGEMENT

↑ COASTAL NONPOINT POLLUTION CONTROL PROGRAMS

As part of the Coastal Zone Act Reauthorization Amendments of 1990, Congress enacted Section 6217 entitled "Protecting Coastal Waters."

This provision requires states with coastal zone management programs (which includes North Carolina) that have received federal approval under Section 306 of the Coastal Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs. The coastal nonpoint programs will provide additional control for sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include: agriculture, forestry operations, urban and developing areas, marinas, hydromodification projects, wetlands and riparian areas.

The coastal nonpoint program will be developed and administered jointly by the NC Division of Coastal Management and DWQ.

CAMA LAND USE PLANS

The Coastal Area Management Act (CAMA), passed in 1974, requires the development of land use plans by each of the 20 coastal counties comprising the coastal area. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazards mitigation, economic development and public participation. Land use plans must be updated every five years. Land use planning guideline revisions made in 1995 strengthened the connection between land use planning and surface water quality. Ninety-one jurisdictions have prepared and adopted CAMA land use plans.

A land use plan is a "blueprint" used by local leaders to help guide the decisions that affect their community. Through land use planning, local jurisdictions can influence how growth will affect surface water quality by adopting policies supported by local ordinances, promoting better sedimentation and erosion control standards, stream buffers and lower levels of impervious surface cover.

↑ FOR MORE INFORMATION...

...visit the NC Division of Coastal Management web site at http://dcm2.enr.state.nc.us/



NC DIVISION OF MARINE FISHERIES

The North Carolina Division of Marine Fisheries (DMF) is responsible for the stewardship of the state's marine and estuarine resources, and its jurisdiction encompasses all coastal waters and extends to 3 miles offshore. Their mission is to maintain, preserve, protect and develop all of North Carolina's marine and estuarine resources.

To meet this mission, the Division of Marine Fisheries is organized into eight sections that report to a Deputy Director and an Executive Director. Agency polices are established by the 17-member Marine Fisheries Commission and Secretary of the Department of Environment and Natural Resources.

◆ FOR MORE INFORMATION...

...visit the NC Division of Marine Fisheries web site at http://www.ncfisheries.net

NCSU COOPERATIVE EXTENSION SERVICE

AGRICULTURAL RESEARCH SERVICE

Crop and animal production programs are administered under the research and education activities of the NC Agricultural Research Service (ARS) and the NC Cooperative Extension Service (CES).

The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers.

A more intensified water quality emphasis is being incorporated in these areas and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

The NC Agricultural Research Service and the NC Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. County Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control.

← FOR MORE INFORMATION...

...visit the NC Cooperative Extension Service online at http://www.ces.ncsu.edu/





Section D-2 State Programs 108

Section E - Water Quality Project Funding Sources

The funding sources listed in this section include federal and state agencies, nonprofits and private funding sources for all types of water quality projects. Funds may be in the form of loans, cost shares or grants.

In addition, the Water Quality Information Center at the National Agricultural Library has compiled an annotated listing of funding sources related to water resources. This listing is located at http://www.nal.usda.gov/wqic/funding.html.

E-1 DENR FUNDING PROGRAMS



SECTION 319

If a local government, environmental group, university researcher or other individual or agency wants to find funding to address a local water quality problem, it is well worth the time to prepare a thorough but concise proposal and submit it to applicable funding agencies. The list of goals for Section 319 proposals can be used as a guideline for other funding agencies. More information on Section 319 grants is available online at http://h2o.enr.state.nc.us/nps/ 319.htm.

CLEAN WATER MANAGEMENT TRUST FUND

Established in 1996 by the General Assembly, the North Carolina Clean Water Management Trust Fund (CWMTF) is an incentive-based program that complements

and extends the state's regulatory framework. Projects funded by CWMTF include those that enhance or restore degraded waters, protect unpolluted waters, and/or contribute toward a network of riparian buffers and greenways for environmental, educational and recreational benefits.

Annually, CWMTF is allocated 6.5% of the unreserved credit balance of the General Fund to finance projects that will abate pollution and restore water quality. Grant proposals can be submitted by local governments, state agencies and conservation nonprofits. Funded projects include 25 projects in the Piedmont (\$20 million), 28 projects in eastern NC (\$26 million), 23 projects in western NC (\$15 million) and 5 statewide/regional projects (\$1.3 million).

Five basic types of projects are funded by the CWMTF: 1) acquisition of property for riparian buffers and greenways; 2) restoration of degraded lands; 3) stormwater control; 4) repair of failing wastewater systems; and 5) water quality planning. For more information on the CWMTF, contact the CWMTF at (252) 830-3222 or www.cwmtf.net.

NC WETLANDS RESTORATION PROGRAM

The North Carolina Wetlands Restoration Program (NCWRP) is responsible for implementing wetland and stream restoration projects to increase wetland acreage, functions and values on a basinwide scale throughout the state to enhance water quality, flood prevention, fisheries, habitat and recreational opportunities.

The NCWRP's restoration efforts are a principal tool for achieving the water quality and aquatic habitat protection and enhancement goals set forth in the Basinwide Water Quality Plans. Funding for the NCWRP's efforts come from two sources: 1) appropriations from the General Assembly for restoration and 2) fees from individuals who are required to do compensatory mitigation for permitted wetlands impacts, but who prefer to pay into the Wetlands Restoration Fund as an alternative to performing their own mitigation.

The NCWRP is not a grant program. However, it can complement grant programs like the 319 program by taking on actual restoration projects that are identified through the 319 grant application process. Alternatively, studies funded by the 319 program to identify suitable stream or wetland restoration sites can then

be implemented by the NCWRP. The NCWRP can also directly fund other restoration projects identified by Nonpoint Source Teams or other means, provided those sites are located within a NCWRP priority subbasin. Finally, the NCWRP can perform restoration projects cooperatively with other state or federal programs or with local groups or land trusts.

The NCWRP is focusing its stream and wetlands restoration work in sixty designated priority subbasins throughout North Carolina and is in the process of identifying prior converted wetlands, stream frontage and riparian buffers that, when restored, can provide significant functions and values on a watershed scale. Landowners who are willing to consider selling either property title or a permanent conservation easement (i.e., a legally binding agreement to allow restoration work and not to allow development) on suitable land are encouraged to contact the NCWRP.

In turn, the NCWRP will determine the restoration potential of the land, and whether it is located in a watershed where restoration can provide much needed wetland or riparian benefits. If mutually acceptable to the NCWRP and the landowner, the latter may receive compensation for land sale or a tax break for a conservation easement.

Information on the NCWRP is available online at http://h2o.enr.state.nc.us/wrp/index.htm or by calling 919-733-5208.



E-2 FUNDING SOURCES FOR POINT SOURCE POLLUTION PROJECTS



Some potential funding sources for point source related water quality management projects include:

FEDERAL

| PROGRAM | CONTACT: |
|---|---|
| US Rural Utilities Service: Water and Wastewater Loan and Grant Program For rural areas and towns up to 10,000 in population who wish to construct, enlarge, extend or otherwise improve water or waste disposal facilities providing essential service primarily to rural residents and businesses. Applicants must provide evidence that they cannot finance desired facilities at reasonable rates and terms. | (910) 246-2885 |
| Rural Business and Cooperative Service: Rural Business Enterprise Grants For rural areas and towns up to 50,000 in population to facilitate and support the development of small and emerging private business enterprises. This includes the construction and development of water and sewer facilities. Grants must either create or save jobs. | One of the RECD Rural Development Managers listed under "Rural Utilities Service" serving the area where the project is located. |
| Appalachian Regional Commission: Supplements to Other Federal Grants in Aid For public bodies and nonprofit groups located in western North Carolina to assist in the improvement of water and sewer facilities which will facilitate the creation or retention of industrial and commercial jobs. | NC Department of Administration 116 West Jones Street Raleigh, NC 27603-8003 (919) 733-7232 |
| US Economic Development Administration: Public Works and Development Facilities Grant Program • For any public or nonprofit agency to assist communities with funding public works and development facilities that contribute to the creation or retention of primarily private sector jobs and alleviation of unemployment and underemployment. | Economic Development Representative PO Box 2522 Raleigh, NC 27601 (919) 856-4570 |

STATE

| PROGRAM | CONTACT: |
|--|--|
| NC Division of Water Quality: Construction Grants and Loans Program Provides grants and loans to local government agencies for the construction, upgrade and expansion of wastewater collection and treatment systems. | Construction Grants/Loans Section Division of Water Quality PO Box 29579 Raleigh, NC 27626-0579 (919) 733-6900 |
| NC Division of Community Assistance: Small Cities Community Development Block Grant For municipalities and counties (except for 22 entitlement cities and Wake and Cumberland counties, which receive money directly from US Department of Housing and Urban Development) to develop viable communities by providing decent suitable living environments and to expand economic opportunities mainly for persons of low to moderate income. Funds may be used for public water/wastewater activities. | NC Division of Community Assistance PO Box 12600 Raleigh, NC 27605-2600 (919) 733-2850 |
| • For counties and their local units of government (with the same exceptions as above) which access the fund on behalf of new or existing manufacturing firms to provide a financing incentive for jobs creation in the state's most economically distressed counties. Funds may be used for a variety of repair, renovation and modification type projects including sewer infrastructure. | Industrial Finance Specialist 301 North Wilmington St. PO Box 29571 Raleigh, NC 27626-0571 (919) 715-6558 |



PRIVATE

PROGRAM CONTACT:

Rural Economic Development Center, Inc.: Supplemental and Capacity Grants Program

- Supplemental Grants Provide funds to match federal and other grants that support necessary economic development projects in economically distressed areas.
- Capacity Grants Enable local governments to acquire short-term capacity for the planning and writing of federal grants that address immediate economic needs.

Senior Associate Wastewater Grants Rural Economic Development Center 1200 St. Mary's Street Raleigh, NC 27605 (919) 715-2725



E-3 FUNDING SOURCES FOR NPS POLLUTION PROJECTS

emphasis on flood control, program now requires off-site water quality benefits.



AGRICULTURE

| PROGRAM NC Agriculture Cost Share Program for NPS Pollution Control (NCACSP) • Provides up to 75% cost share, as well as technical assistance, for practices that protect water quality in agricultural areas. | CONTACT: NC Division of Soil and Water Conservation (919) 715-6107 |
|---|---|
| Environmental Quality Incentives Program (EQIP) Establishes conservation priority areas agricultural lands with significant water, soil and related natural resource problems. Provides 5 to 10-year contracts to pay up to 75% of the cost of conservation practices such as manure management systems, IPM and erosion control. USDA also provides technical assistance. | USDA Farm Service Agency 4407 Bland Road Suite 175 Raleigh, NC 27609 (919) 790-2867 |
| Conservation Reserve Program (CRP) Payments to farmers who voluntarily take highly erodible land out of production for at least ten years. Annual rental payments along with 50% cost share for establishment of permanent cover (grass, trees). | USDA Farm Service Agency 4407 Bland Road Suite 175 Raleigh, NC 27609 (919) 790-2867 |
| Emergency Conservation Program Provides technical assistance and direct cost share payments for agricultural producers who, without federal assistance, cannot rehabilitate their private farmland after a natural disaster. Payments are limited to 64% of the first \$62,400, 40% of the second \$62,400, and 20% of the cost above \$125,000. | USDA Farm Service Agency 4407 Bland Road Suite 175 Raleigh, NC 27609 (919) 790-2867 |
| Farm Debt Cancellation-Conservation Easement Program Farm Service Agency credit borrowers who have loans secured by real estate and have qualifying land may be given debt cancellation on outstanding loan balances in exchange for conservation easements. The cancellation may not exceed 33% of the principal for current borrowers or the fair market value of the easement for delinquent borrowers. | USDA Farm Service Agency 4407 Bland Road Suite 175 Raleigh, NC 27609 (919) 790-3057 |
| Provides guaranteed loans to, among other things, enhance and protect land and water resources including pollution abatement and control. Eligible recipients include farmowners/operators who are unable to obtain financing at reasonable rates or rates that allow them to maintain a positive cash flow. | USDA Farm Service Agency 4407 Bland Road Suite 175 Raleigh, NC 27609 (919) 790-3057 |
| Wetland Reserve Program (WRP) Allows farmers to sell permanent wetland easements to USDA. Also provides cost share to restore altered wetlands to natural condition. Eligible land includes prior converted cropland, farmed wetlands, and riparian areas along streams or watercourses that link protected wetlands. | USDA Natural Resources Conservation Service Contact your local conservationis |
| Small Watershed Program, PL-566 • Technical and financial assistance for projects protecting and developing small watersheds. Historic | NC Division of Soil and Water Conservation |



(919) 715-6110

EDUCATION

| PROGRAM | CONTACT: |
|--|--|
| GTE Foundation Supports projects improving math and science for underrepresented groups. | GTE Foundation GTE Corporate Communications One Stamford Forum Stamford, CT 06904 (203) 965-3620 |
| Toyota TAPESTRY Grants • Supports innovative science education by teachers in environmental education and physical science. | National Science Teachers Association Toyota Tapestry 1840 Wilson Blvd. Arlington, VA 22201-3000 (703) 312-9258 |
| Toshiba America Foundation • Supports secondary school science and math education. | Toshiba America Foundation 1251 Avenue of the Americas Suite 4100 New York, NY 10020 (212) 596-0600 |
| Digital Equipment Corporation • Supports science and math education through school-based and community-linked organizations. | Programs Manager, Corporate Contributions Programs Digital Equipment Corp. 110 Powder Mill Rd. MSO 1/L14 Maynard, MA 01754-1418 (508) 493-6550 |
| National Environmental Education and Training Foundation (NEETF) Provides funds for environmental education projects that foster informed decision-making, target adults and adolescents in informal educational settings, and address environmental issues affecting health. Require at least a 50% cash match provided by a nonfederal source other than the award recipient. | NEETF 915 Fifteenth St. NW Suite 200 Washington, DC 20005 (202) 628-8200 |

RESEARCH

| PROGRAM | CONTACT: |
|---|--|
| Environmental Contaminants - Identification and Assessment Provides short and medium duration studies/investigations of contaminant exposure and effect to individuals and organizations with a need for such information. Applicants must provide matching funds or in-kind services. | US Fish and Wildlife Service PO Box 33726 Raleigh, NC 27636-3627 (919) 856-4520 |
| National Research Initiative Competitive Grants Program Supports research on key problems of national and regional importance in biological, environmental, physical and social science relevant to agriculture, food and the environment, including assessment and protection of water resources. Scientists at public and private agencies and universities are eligible. | USDA - CSREES National Research Initiative Competitive Grants Program Room 323, Aerospace Center AG Box 2241 Washington, DC 20250-22441 (202) 401-5022 (Request for proposals published annually in the Federal Register.) |
| Environmental Contaminants - Prevention Provides technical and engineering support to prevent contaminant problems. No direct financial assistance is provided. | US Fish and Wildlife Service PO Box 33726 Raleigh, NC 27636-3627 (919) 856-4520 |
| Environmental Geochemistry and Biogeochemistry Research Program Supports interdisciplinary research on how chemical and biological processes in nature alter water quality. A minimum 1% cost share is required. Eligible recipients are scientists, engineers and educators at universities and other not-for-profit institutions. | National Science Foundation Division of Earth Sciences Director, Environmental Chemistry and Geochemistry Program 4201 Wilson Blvd. Arlington, VA 22230 (703) 306-1554 |
| Hydrologic Science Research Program Supports research in hydrologic science on the quality of waters in streams and aquifers. A minimum 1% cost share is required. Eligible recipients are scientists, engineers and educators at universities and other not-for-profit institutions. | National Science Foundation Division of Earth Sciences Director, Hydrologic Sciences Program 4201 Wilson Blvd. Arlington, VA 22230 (703) 306-1549 |
| Water and Watersheds Research Program A joint NSF/EPA special awards program to support interdisciplinary teams joining the physical, biological and socioeconomic sciences and engineering in research on water quality issues. A minimum 1% cost share is required. Eligible recipients are scientists, engineers and educators at universities and other not-for-profit institutions. | National Science Foundation Directorate for Biological Sciences Executive Officer 4201 Wilson Blvd. Arlington, VA 22230 (703) 306-1400 |
| River Network - Watershed Assistance Grants Program Supports river and watershed advocates at the local, state and regional levels to build effective partnerships and organizations. Will distribute grants ranging from \$2,000 to \$30,000 in 1999 to support watershed partnerships working to protect and restore their watersheds. | River Network, Watershed Assistance Grants Program PO Box 8787 Portland, OR 97207 http://www.rivernetwork.org/ nonprofit.htm |



WATER QUALITY PLANNING

| PROGRAM | CONTACT: |
|---|--|
| Soil and Water Conservation Program Provides technical assistance to local governments for resource planning and management to improve water quality and reduce pollution. | USDA, NRCS Contact your local conservationist |
| Floodplain Management Services • Provides information and data on floods and actions to reduce flood damage to local governments. | US Army Corps of Engineers, Planning Division Directorate of Civil Works Floodplain Management Services 20 Massachusetts Ave., NW Washington, DC 20314-1000 (202) 761-0169 |
| Resource Conservation and Development Program Provides funds and technical assistance to local governments and nonprofits to plan, develop and implement programs for resource conservation and community sustainability. | RC&D Executive Director Blue Ridge RC&D Council, Inc. PO Box 2 Boone, NC 28607 (704) 265-4005 |
| River Basin Surveys and Investigations Provides planning assistance to local agencies to develop coordinated water and related land resource programs, with priority given to solving upstream flooding of rural communities, improving water quality from agricultural nonpoint sources, and wetland preservation, etc. | USDA, NRCS Director, Watersheds and Wetlands Division PO Box 2890 Washington, DC 20013 (202) 720-3534 |
| Watershed Protection and Flood Preventions (Small Watershed Program) Provides monitoring, loans, cost share and technical assistance for the installation of land treatment measures. Provides up to 100% of the cost of structural flood prevention measures. Eligible agencies include local government, nonprofits and SWCDs. | USDA, Natural Resources Conservation Service Contact your local conservationist |
| NC Division of Water Resources Stream Repair Funding • Provides cost share funds and technical assistance in stream restoration projects to local governments. | NCDWR PO Box 27687 Raleigh, NC 27611-7687 (919) 733-4064 |
| Rivers, Trails and Conservation Assistance Program Provides technical assistance for assessing resources, identifying land protection strategies, and developing organizations to address environmental concerns. | Great Smoky Mountains National Park 107 Park Headquarters Gatlinburg, TN 37738-4102 (423) 436-1246 |
| Section 205(j) Water Quality Planning Grants Provides funds for planning activities such as developing plans for meeting and maintaining local water quality standards, implementing such plans, and determining the nature, extent and causes of water quality problems. | Division of Water Quality Planning Branch PO 29535 Raleigh, NC 27607 (919) 733-5083 ext. 566 |

FORESTRY, RECLAMATION AND LAND CONSERVATION

| PROGRAM | CONTACT: |
|--|---|
| Forestry Stewardship Incentive Program Forestry: Up to 50% cost share (max \$7,500/person-yr) to enhance management of non-industrial private forestlands to increase timber supply and improve fish and wildlife habitat and recreation. | NC Division of Forest Resources PO Box 29581 Raleigh, NC 27626 (919) 733-2162 ext. 241 |
| Forestry Incentives Program Forestry: Up to 50% funding for tree planting and stand improvement to increase supplies from non-industrial private forestlands. | NC Division of Forest Resources PO Box 29581 Raleigh, NC 27626 (919) 733-2162 ext. 241 |
| Rural Abandoned Mine Program Reclamation: Direct payments of up to 100% in cost share funds for conservation practices determined to be needed for reclamation, conservation and development of up to 320 acres per owner of rural abandoned coal mine land or lands and waters affected by coal mining. | USDA - NRCS Contact your local conservationist |
| Environmental Contaminants Natural Resource Damage Assessment Reclamation: Provides funding for the assessment of damage to water quality and trust resources from oil spills and/or other hazardous substance releases for individuals or organizations interested in the restoration of fish and wildlife, including aquatic habitat and water quality. | US Fish and Wildlife Service PO Box 33726 Raleigh, NC 27636-3627 (919) 856-4520 |
| • Land Conservation: Allows credit against individual and corporate income taxes when real property is donated for conservation purposes. Interests in property that promote fish, wildlife, etc., conservation purposes may be donated to a qualified recipient for a substantial tax credit (currently 25% of the value of the gift up to \$25,000). | NCDENR (919) 715-4191 |





APPENDIX 1

FEDERAL AND STATE AUTHORITIES FOR NC WATER QUALITY PROGRAMS

FEDERAL AUTHORITIES FOR NORTH CAROLINA'S WATER QUALITY PROGRAM

- Section 301 Prohibits the discharge of pollutants into surface waters unless permitted by EPA.
- Section 303(c) States are responsible for reviewing, establishing and revising water quality standards for all surface waters.
- Section 303(d) Each state shall identify those waters within its boundaries for which the effluent limits required by Section 301(b)(1) A and B are not stringent enough to protect any water quality standards applicable to such waters.
- Section 305(b) Each state is required to submit a biennial report to the EPA describing the status of surface waters in that state.
- Section 319 Each state is required to develop and implement a nonpoint source pollution management program.
- Section 402 Establishes the National Pollutant Discharge Elimination System (NPDES) permitting program. Allows for delegation of permitting authority to qualifying states (includes North Carolina).
- Section 404/401 Section 404 regulates the discharge of fill materials into navigable waters and adjoining wetlands unless permitted by the US Army Corps of Engineers. Section 401 requires the Corps to receive a state Water Quality Certification prior to issuance of a 404 permit.

STATE AUTHORITIES FOR NORTH CAROLINA'S WATER QUALITY PROGRAM

- G.S. 143-214.1 Directs and empowers the NC Environmental Management Commission (EMC) to develop a water quality standards and classifications program.
- G.S. 143-214.2 Prohibits the discharge of certain wastes to surface waters of the state without a permit.
- G.S. 143-214.5 Provides for establishment of the state Water Supply Watershed Protection Program.
- G.S. 143-214.7 Directs the EMC to establish a Stormwater Runoff Program.
- G.S. 143-215 Authorizes and directs the EMC to establish effluent standards and limitations.
- G.S. 143-215.1 Outlines methods for control of sources of water pollution (NPDES and non-discharge permits, statutory notice requirements, public hearing requirements, appeals, etc.).
- **G.S.** 143-215.2 Empowers the EMC to issue *special orders* to any person whom it finds responsible for causing or contributing to any pollution of the waters of the state within the area for which standards have been established.
- G.S. 143-215.3 Outlines additional powers of the EMC including provisions for adopting rules, charging permit fees, delegating authority, investigating fish kills and investigating violations of rules, standards or limitations adopted by the EMC.
- G.S. 143-215.6A, 143-215.6B and 143-215.6C Includes enforcement provisions for violations of various rules, classifications, standards, limitations, provisions or management practices established pursuant to G.S. 143-214.1, 143-214.2, 143-214.5, 143-215. Section 6A describes enforcement procedures for civil penalties. Section 6B outlines enforcement procedures for criminal penalties. Section 6C outlines provisions for injunctive relief.
- G.S. 143-215.74, 75A, 74B, 74C, 74D and 74E Refers to animal waste management and agriculture cost share.
- G.S. 143-215.75 Outlines the state's Oil Pollution and Hazardous Substances Control Program.
- G.S. 143-215, 10A 215.10G Requires permits and controls for animal waste systems.
- G.S. 143-214.8 214.13 Establishes a Wetland Restoration Program.
- G.S. 143-15.3B, 113-145.1-145.7 Establishes a Clean Water Management Trust Fund.

APPENDIX 2

BEST MANAGEMENT PRACTICES (BMPs) FOR CONTROLLING NPS POLLUTION

Lists of BMPs for:

- 1. Agriculture
- 2. Urban Runoff
- 3. Erosion and Sedimentation Control
- 4. On-Site Wastewater Disposal
- 5. Solid Waste Disposal
- 6. Forestry
- 7. Mining
- 8. Hydrologic Modifications

1. BMPs FOR AGRICULTURE

Nonpoint source pollution has been identified by the NC Division of Water Quality as the primary source of degradation of freshwater rivers and streams in North Carolina. About 17% of North Carolina's freshwater rivers and streams are impaired and do not fully support their intended uses (out of 91% evaluated). Most widespread sources are agriculture (53% of use support impairment/ 9% of total stream miles), urban runoff and construction. Sediment (48% of use support impairment/ 8% of total miles) is the most widespread cause of water quality degradation (DWQ 1996 305b).

The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community. This approach is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

Financial incentives are provided through North Carolina's Agriculture Cost Share Program. This program is administered by the Division of Soil and Water Conservation (Division) in the Department of Environment and Natural Resources. It has been applauded by the US Environmental Protection Agency and has received wide support from the public as well as the state's agricultural community. The Cost Share program was authorized in 1983 as a pilot program to address nonpoint source problems in the nutrient sensitive waters of Jordan Lake, Falls Lake, and the Chowan River covering 16 counties. Due to the program's success, it has been extended to all 96 Soil and Water Conservation Districts (Districts) that includes all 100 counties.

While the Soil and Water Conservation Commission (Commission) has the statutory responsibility to create, implement and supervise the Cost Share program, it is delivered at the local level by 492 elected and appointed volunteer District Supervisors who are assisted by a cadre of experts. The experts are employees of the US Department of Agriculture's Natural Resources Conservation Service (NRCS), the NC Department of Agriculture and Consumer Services, the Cooperative Extension Service, the Division of Soil and Water Conservation and the District or county.

Participating farmers receive 75% of predetermined average costs of installed best management practices (BMPs) with the remaining 25% paid by farmers directly or through in-kind contributions. Some applicants may be eligible to receive as much as \$75,000 per year. In addition, the program provides local Districts with matching funds (50:50) to hire personnel to plan and install the needed BMPs. The Commission allocates cost share funds to local Districts based on the level of state appropriations and water quality protection priorities.

Cost Share allocation and funding decisions by District Boards are based on their written strategy plans. After receiving their allocation, District Boards review applications from landowners for Cost Share funding and decide who will be funded for BMP installation. The written strategy plans are used to prioritize the BMPs in terms of effectiveness for water quality protection. District Boards are encouraged to place the highest priority on the most cost effective water quality protection measures.

Completed BMPs under the program are subject to random checks by the Division staff and District personnel. Additional checks are required if the BMP relates to animal waste management.

Farmers who fail to maintain their BMPs in proper working order are subject to repaying some or all of the original cost share funds.

Since the first cost share contracts were issued in 1984, there have been approximately 24,091 contracts approved for installing BMPs through the end of the 1997 program year, which ended June 30, 1997. It has been estimated that an average of 1.5 million tons of soil has been saved annually during the life of the program.

From its inception, state taxpayers have invested approximately \$75.5 million in improved water quality through the installation of BMPs. In the 1996-1997 fiscal year, the Cost Share program received \$15,934,897 in state appropriations. The \$15.9 million included \$7.5 million to bring old animal operations into compliance with the new standards under the .0200 rules. The program cost shared 118 full and part time District technical positions to plan, design and install agricultural BMPs to improve water quality. The Cost Share program is currently budgeted for \$6.9 million in non-reverting, recurring funds.

Highlights of additional accomplishments include the following (1985-1997):

- 74,655 acres of cropland have been converted to trees or grass.
- 58 structures have been built for the proper handling and storage of agricultural chemicals.
- 1,875 waste management structures have been constructed to properly store dry and wet animal waste.
- 3,194 water level management structures affecting 678,379 acres have been installed.

BMPs ELIGIBLE FOR COST SHARE PAYMENTS

BMPs eligible for cost sharing include the following practices and any approved District BMPs. District BMPs shall be reviewed by the Division for technical merit in achieving the goals of this program. Upon approval by the Division, the District BMPs will be eligible to receive cost share funding.

The minimum life expectancy of the BMPs is also listed. Practices designated by a District shall meet the life expectancy requirement established by the Division for that District BMP. The list of BMPs eligible for cost sharing may be revised by the Commission as deemed appropriate in order to meet program purpose and goals.

| Purpose: Sediment/Nutrient Delivery Reduction From Fields | | | | | |
|---|-------------------------------------|------------------------|-----------------------|---------------------|-------------------|
| ВМР | Reduction of applied nutrient | Reduction of soil loss | Nutrient interception | Facilitating BMP | Life of BMP (yr.) |
| Field Border | - | ✓ | ✓ | - | 10 |
| Filter Strip | - | V | ✓ | - | 10 |
| Grade Stabiliz. Structure | - | ✓ | - | - | 10 |
| Grassed Waterway | - | ✓ | ✓ | - | 10 |
| Nutrient Management | ' | - | - | - | 3 |
| Riparian Buffer | - | V | ✓ | - | 10 |
| Rock-Lined Outlet | - | / | - | - | 10 |
| Sediment Control Basin | - | V | ✓ | - | 10 |
| Water Control Structure | - | _ | V | - | 10 |
| Streambank Stabilization | - | ' | ✓ | - | 10 |

| Purpose: Erosion Reduction/Nutrient Loss in Fields | | | | | |
|--|-------------------------------|-------------------|--------|--|--|
| ВМР | Reduction of applied nutrient | Life of BMP (yr.) | | | |
| Conservation Tillage | - | ✓ | 1 | | |
| Critical Area Planting | - | ✓ | 10 | | |
| Cropland Conversion | ✓ | ✓ | 10 | | |
| Water Diversion | - | ✓ | 10 | | |
| Long Term No-Till | - | ✓ | 5 | | |
| Pastureland Conversion | ✓ | ✓ | 10 | | |
| Sod-Based Rotation | ✓ | ✓ | 4 or 5 | | |
| Stripcropping | ✓ | ✓ | 5 | | |
| Terraces | - | ✓ | 10 | | |

| PURPOSE: AGRICULTURAL CHEMICAL POLLUTION PREVENTION | | | | |
|---|---|----|--|--|
| BMP Interception of chemicals Life of BMP (yr.) | | | | |
| Agri-Chemical Handling Facility | V | 10 | | |

| Purpose: Proper Animal Waste Management | | | | | | |
|---|---------------------------|----------|-----------------------|------------------|----------------------|--|
| ВМР | Proper mgmt. of nutrients | | Nutrient interception | Facilitating BMP | Life of BMP (yr.) | |
| Animal Waste Lagoon Closure | ✓ | - | - | - | 5 | |
| Constructed Wetlands | ✓ | - | - | - | 10 | |
| Controlled Livestock Lounging Area | - | ✓ | - | ' | 10 | |
| Dry Manure Stack | ✓ | - | - | - | 10 | |
| Heavy Use Area Protection | - | ✓ | - | - | 10 | |
| Insect Control | - | - | - | - | 5 | |
| Odor Control | - | - | - | - | 1-10 | |
| Storm Water Management | ✓ | - | - | - | 10 | |
| Waste Storage Pond/Lagoon | ✓ | - | - | - | 10 | |
| Waste/Animal Composter | ~ | - | - | - | 10 | |
| Waste Application System | ~ | - | - | ' | 10 | |
| Dry Litter Incentive | V | - | - | - | 1 | |

| PURPOSE: STREAM PROTECTION FROM ANIMALS | | | | | | |
|---|-------------------------------|------------------------|---------------------|-------------------|--|--|
| ВМР | Reduction of applied nutrient | Reduction of soil loss | Facilitating BMP | Life of BMP (yr.) | | |
| Heavy Use Area Protection | - | ✓ | - | 10 | | |
| Livestock Exclusion System | ✓ | ✓ | - | 10 | | |
| Spring Development | - | - | ✓ | 10 | | |
| Stock Trail | - | ✓ | - | 10 | | |
| Stream Crossing | - | ✓ | - | 10 | | |
| Trough or Tank | - | - | ✓ | 10 | | |
| Well | - | - | ✓ | 10 | | |
| Windmill | - | - | ✓ | 10 | | |

2. BMPs FOR URBAN STORMWATER

Structural Best Management Practices for urban runoff control are typically designed to reduce sediment, its attached pollutants and nutrients. In addition, other BMPs protect the riparian ecosystem, provide streambank stabilization, provide shade to waterbodies, and reduce the likelihood of excessive water temperatures. Nonstructural BMPs, such as a design manual or a public education program, encourage the comprehensive and effective implementation of structural BMPs.

The table below contains a list of both structural and nonstructural BMPs. This list is taken from the *Stormwater Management Guidance Manual*, published by DWQ's Water Quality Planning Branch in 1995. The *Manual* provides a detailed discussion of each of the BMPs, including its characteristics, pollutant-specific effectiveness, reliability, feasibility, costs, unknown use factors, design considerations and references for further information.

| STRUCTURAL BMPs | NONSTRUCTURAL BMPs | |
|--|--|---|
| Wet Detention Basin Constructed Wetlands Wet Retention Basin Dry Detention Basin Infiltration Basin Vegetative Practices Filter Strips Grass Swales with Check Dams Sand Filter Oil and Grease Separator Rollover-Type Curbing | Preventive Measures Pollutant Minimization Exposure Reduction (proper scheduling, etc see Manual) Landscaping and Lawn Maintenance Controls Animal Waste Collection Curb Elimination Parking Lot and Street Cleaning Road Salt Application Control Catch Basin Cleaning Riparian Area Protection | Design Manual for Urban BMPs Public Education Identification and Enforcement of Illegal Discharges Land Use Control Low density Development Comprehensive Site Planning Buffer Zone Sanitary Waste Management Conservation Easement |

Structural BMPs may affect groundwater quality in certain situations. Devices that recharge groundwater pose the risk of passing soluble pollutants into groundwater systems. It is not currently known whether pollutant concentrations in recharged groundwater areas pose a significant environmental or health risk. USGS is presently studying groundwater quality effects of urban BMPs. In addition, if funds are made available, DWQ may conduct a similar study in North Carolina.

| SUBSTITUTIONS FOR HOUSEHOLD HAZARDOUS SUBSTANCES | | |
|--|---|--|
| Instead of | Try | |
| Ammonia-Based Cleaners | Vinegar + Salt + Water | |
| Abrasive Cleaners | Lemon Dipped in Borax or Salt + Baking Soda | |
| Furniture Polish | Lemon Juice + Olive Oil | |
| Toilet Cleaner | Baking Soda + Toilet Brush | |
| Oven Cleaner | Liquid Soap + Borax + Warm Water | |
| Drain Cleaners | Boiling Water + Baking Soda + Vinegar | |
| Upholstery Cleaners | Dry Cornstarch | |
| Mothballs | Cedar Chips or Lavender Flowers | |
| Window Cleaner | White Vinegar + Water | |
| Oil-Based Paints and Stains | Water-Based Paints and Stains | |

| RECOMMENDATIONS FOR URBAN STORMWATER CONTROL | | |
|--|--|--|
| Local Governments | Create public education programs advising citizens on how to minimize stormwater pollution. Support stream cleanup programs such as Big Sweep. Create and enforce strict penalties for improper waste disposal. Fence dumpsters and clean them regularly. Institute land use planning which reduces flooding by limiting impervious surfaces, directs runoff into vegetated areas or stormwater control devices, and directing growth away from sensitive areas. These actions will help protect water quality. Review local ordinances pertaining to parking, curb and gutter locations. Design parking lots with overflow areas in grass. Eliminate curbs and gutters to allow runoff to flow in sheetflow. Protect open spaces and streamside buffers by preserving recreational areas and significant natural resources. Attend stormwater workshops. For more information, contact the DWQ Stormwater and General Permits Unit at (919) 733-5083. Map the storm sewer system to identify stormwater problems. Offer hazardous waste collection days. | |
| Citizens | Participate in stream cleanup programs such as Big Sweep. Practice environmentally friendly lawn care. Use less-harmful substances in the home for cleaning or painting to reduce the risk of problems with septic tanks and sanitary sewers. Educate adults and children on protecting water quality. For information contact the NC Office of Environmental Education, (919) 733-0711. Use hazardous waste collection centers for paints, petroleum products and other chemicals. Never dispose of oil, yard wastes or other materials in storm drain inlets or on lands which drain directly to nearby streams. Maintain and protect riparian buffers on private property. Buffers remove pollutants, including sediment, nutrients and toxic substances. They are also a cost-effective form of flood insurance and can increase property value. Support your local government's land use planning initiatives. | |
| Developers | Incorporate stormwater management in project planning and avoid environmentally sensitive areas, such as floodplains and wetlands. Maintain natural drainage ways and buffers along streams. | |
| Businesses | Maintain and protect riparian buffers on commercial property. Buffers remove sediment, nutrients and toxic substances. Cover and contain waste materials to prevent contaminated runoff from disposal areas. Practice good housekeeping and promote good water quality by operating a clean and litter-free facility. Institute hazardous waste collection sites for used oil, antifreeze, paint and solvents. | |

3. BMPs FOR EROSION AND SEDIMENTATION CONTROL

Best Management Practices, as suggested in the NC Sedimentation Pollution Control Act of 1973, are selected on the basis of performance in providing protection from the maximum peak rate of runoff from a 10-year storm. This allows the developer/designer of the control measures, structures or devices to determine and submit for approval the most economical and effective means of controlling erosion and preventing sedimentation damage.

Practices are therefore reviewed for acceptability based upon the characteristics of each individual site and its erosion potential. Ideally, the erosion control plan will employ both practices and construction management techniques which will provide the most effective and reasonable means of controlling erosion, while considering the uniqueness of each site.

The following table provides a list of practices commonly used in sedimentation and erosion control plans across North Carolina.

- · Check Dam
- · Construction Road Stabilization
- Dust Control
- Grade Stabilization Structure
- Grass-Lined Channels
- Grass Channels with Liner
- Land Grading
- Level Spreader
- Mulching
- Outlet Stabilization Structure
- Paved Channels
- Paved Flume (Chutes)
- Perimeter Dike
- Permanent Diversions
- Permanent Seeding
- Permanent Stream Crossing
- · Right-of-Way Diversions
- Riprap
- Riprap-Lined Channels
- Rock Dam
- Sand Fence (Wind Fence)

- Sediment Basin
- Sediment Fence
- Sod Drop Inlet Protection
- Soddina
- Structural Streambank Stabilization
- Subsurface Drain
- Surface Roughening
- Temporary Block & Gravel Inlet Protection
- Temporary Diversions
- Temporary Excavated Drop Inlet Protection
- Temporary Fabric Drop Inlet Protection
- Temporary Gravel Construction Entrance/Exit
- Temporary Sediment Trap
- Temporary Seeding
- Temporary Slope Drains
- Temporary Stream Crossing
- Topsoiling
- Tree Preservation & Protection
- Trees, Shrubs, Vines & Ground Covers
- Vegetative Dune Stabilization
- Vegetative Streambank Stabilization

4. BMPs FOR ON-SITE WASTEWATER DISPOSAL

To protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal system. Life cycle management problems can be addressed in three phases (Steinbeck, 1984). The first phase includes system siting, design and installation. The second phase involves the operation of the system, and phase three involves maintenance and repair when the system malfunctions or fails.

As BMPs are applied in each life cycle phase, the primary factor for the success of the system is the participation of the local influencing health department and the cooperation of the developer, owner, design engineer, system operator and the state.

The following list is a summary of the current life cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program (Steinbeck, 1984).

- 1. Application -- The developer or property owner meets with the staff of the local health department to review the project proposal and submits an application to the local health department that contains information regarding ownership, plat of property, site plan, type of facility, estimated sewage flow, proposed method of sewage collection, treatment and disposal.
- 2. Site Evaluation -- The local health department, with technical assistance from the state, evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth and space requirements. Next, the local health department will assign a site suitability classification, establish the design sewage flow, and the design-loading rate for the soil disposal system.
- 3. Design Review -- The applicant is required to submit plans and specifications prepared by a professional engineer for the sewage collection, treatment and disposal system of complex systems, or for systems exceeding 3,000 gal/day. Reviews are made by both state and local health departments. The designer must also include in the plans and specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements, and designate the responsible agents for operation and maintenance.
- 4. Legal Document Review -- For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to state and local health departments for their legal review documents applicable to the project.
- 5. Improvement Permit -- Issued only after a successful review of the proposed project, including each of the items discussed above and allows construction to begin for the on-site sewage system. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site. This permit contains the necessary conditions for construction of the projects with the plans, specifications and legal documentation appended to it.

- 6. Operation Permit -- Issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met; all conditions on the improvement permit are met; and the design engineer for the sewage collection, treatment and disposal system certifies in writing to the local health department that the on-site system has been installed in accordance with the approved plans and specifications. The operation permit is also conditioned to establish performance requirements and may be issued for a specific period. It allows the on-site sewage system to be placed into use, prevents permanent electrical service to the project, and prevents occupancy of the facilities until issued. The operation permit applies to systems larger than 480 gallons per day. A certificate of completion is required for conventional septic tank systems when the design sewage flow is less than 480 gal/day.
- 7. Surveillance -- Once an on-site sewage system is placed into operation, the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, required monitoring reports are routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department.
- 8. Remedies -- When voluntary compliance with the performance requirements for the on-site system is unsuccessful, the General Statutes (1983) provide for the following remedies:
 - (a) Right of Entry -- Allows the state or local health department to enter the premises to determine compliance with the laws and rules, and provides for an administrative search and inspection warrant when entry is denied.
 - (b) Injunction -- The state or local health department may institute an action for injunctive relief against the owner to bring the on-site sewage system into compliance.
 - (c) Order of Abatement -- The state or local health department is empowered to issue an order of abatement directing the owner to take any necessary action to bring the system into compliance. However, if the on-site system is determined to be creating an imminent health hazard, the state or local health department may, after previous unsuccessful attempts at correction, take the necessary action to correct the problem and recover any costs for abatement from the owner. This is the least frequently applied remedy.
 - (d) Administrative Penalties -- The State may impose administrative penalties up to \$300 per day for violation of the laws, rules or any permit condition for on-site sewage systems serving multifamily residences with a flow greater than 480 gal/day. A penalty of up to \$50 per day can be assessed for malfunctioning systems where the flow is less than or equal to 480 gal/day.
 - (e) Suspension and Revocation of Permits -- The State may suspend or revoke a permit for violations of the laws, rules or permit conditions upon a finding that a violation has occurred.
 - (f) Misdemeanor -- The owner who violates the sewage laws or rules shall be guilty of a misdemeanor and punishable by a fine or imprisonment as determined by the courts. This is the most frequently used remedy.

5. BMPs FOR SOLID WASTE MANAGEMENT

Best Management Practices for solid waste management address the water quality impacts of leachate migration and surface erosion. A list of BMPs for controlling solid waste impacts on water quality can be found in the table below.

The BMPs offer significant benefits for groundwater quality. Landfill liners will prohibit or greatly decrease the volume of leachate entering groundwater. In turn, leachate collection systems capture leachate for subsequent treatment rather than groundwater disposal. For even greater protection, groundwater and surface water monitoring should detect failures in the liner or collection system.

- Reduce, Recover and Recycle Solid Waste to Maximum Extent
- Incineration with Energy Recovery
- North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities, 1987
- Liners (Clay or Synthetic) for All New Landfills
- Leachate Collection Systems
- Erosion Control Plan
- Operation and Maintenance Plan
- Buffers Between Landfill and Streams, Property Lines and Dwellings
- Groundwater Quality Monitoring
- · Surface Water Quality Monitoring
- Public Education
- Stormwater Runoff Control
- Sedimentation Control

6. BMPs FOR FORESTRY

A. PERFORMANCE STANDARDS FOR FORESTRY SITE DISTURBING ACTIVITIES IN NORTH CAROLINA

Forest Practices Guidelines Related to Water Quality (15A NCAC 1I.0101-.0209) have been adopted as published in the NCR, Volume 4, Issue 11, pages 601-604, and were effective January 1, 1990. These guidelines are summarized below.

Streamside Management Zone (SMZ)

- Must establish SMZ along natural, intermittent and perennial streams and waterbodies. (Not required along man-made ditches and canals, although erosion protection is needed).
- Must have sufficient width and adequate ground cover to confine visible sediment (usually best to protect existing ground cover).
- · Place roads, trails and decks outside of SMZ.
- Limited cutting (harvesting) is permitted within the SMZ.

Prohibition of Debris Entering Streams

- Prevent debris (logging slash, soil) of all types that can cause streamflow impediment or water quality degradation from entering intermittent and perennial streams and waterbodies.
- Remove debris that accidentally enters streams.

Access Road and Skid Trail Stream Crossing

- · Avoid crossing streams where possible.
- Avoid using stream channels as roads or trails.
- · Construct crossings to minimize sediment entering streams.
- · Protect streambanks and channels from damage.
- Provide water control devices and/or structures.
- Provide ground cover sufficient to restrain accelerated erosion and prevent stream sedimentation within 10 working days of initial disturbance.

Access Road Entrance

Prevent soil and debris from being deposited on public highways, which may result in stream sedimentation.

Keep Waste from Entering Streams, Waterbodies and Groundwater

• Prevent oil, fuels, fertilizer and other chemical waste from entering streams, waterbodies and groundwater.

Pesticide Application

• Application must follow labeling and NC Pesticides Board rules. Includes insecticides, fungicides, herbicides and rodenticides.

Fertilizer Application

· Apply in a manner to prevent adverse impacts on water quality.

Stream Temperature

• Retain shade sufficient to prevent temperature fluctuations that result in a violation.

Rehabilitation of Project Site

- Within 30 working days after ceasing operations, provide sedimentation control measures to prevent water quality damage.
- Permanently stabilize SMZ areas and other areas that may directly contribute visible sediment to streams.

The Forestry Best Management Practices Manual was prepared to provide the means of meeting the above standards. The Manual is available from any DFR office at no charge.

B. BMPs FOR FORESTRY OPERATIONS IN WETLANDS

The Division of Forest Resources is in the process of developing BMPs for forested wetlands. Economic pressure to expand forestry activities in wetlands continues to increase. This expansion will require a sound strategy to protect these environmentally sensitive areas.

A Forested Wetlands BMP Committee was established in 1987. The members represented state and federal agencies, industry, education and conservation groups. In 1990, the *Best Management Practices for Forestry in the Wetlands of North Carolina* was published. The committee has been reconvened and

is currently working to revise and update the wetland BMPs. This update will take into account the Corps of Engineer's and EPA's *Application of Best Management Practices to Mechanical Site Preparation Activities for the Establishment of Pine Plantations in the Southeast*. This EPA guidance restricts the areas that can be mechanically site prepared for planting in loblolly pine without a Section 404 permit.

In addition to the state's voluntary wetland BMPs, the Corps of Engineers has produced 15 mandatory BMPs for forest and farm road construction and maintenance in forested wetlands. These BMPs must be followed; or else a Section 404 permit is required for the road construction or maintenance. The 15 BMPs are:

- 1. Permanent roads (for forestry), temporary access roads (for forestry) and skid trails (for logging) in waters of the US shall be held to the minimum feasible number, width and total length consistent with silvicultural, local topographic and climatic conditions.
- 2. All roads shall be located sufficiently far from streams or other waterbodies (except for portions of such roads that must cross waterbodies) to minimize discharges of dredged or fill material into waters of the US.
- 3. Road fill shall be bridged, culverted or otherwise designed to prevent the restriction of expected flood flows
- 4. Fill shall be properly stabilized and maintained to prevent erosion during and following construction.
- 5. Discharges of dredged or fill material into waters of the US to construct road fills shall be made in a manner that minimizes encroachment of trucks, tractors, bulldozers and other heavy equipment into waters of the US (including adjacent wetlands that lie outside the lateral boundaries of the fill itself).
- 6. In designing, constructing and maintaining roads, vegetative disturbance in waters of the US shall be kept to a minimum.
- 7. Design, construction and maintenance of road crossings shall not disrupt the migration or other movement of those aquatic species inhabiting the waterbody.
- 8. Borrow material shall be taken from upland sources whenever feasible.
- 9. The discharge shall not take or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species.
- 10. Discharges into breeding and nesting areas for migratory waterfowl, spawning areas and wetlands shall be avoided if practical alternatives exist.
- 11. Discharge shall not be located in proximity to a public water supply intake.
- 12. The discharge shall not occur in areas of concentrated shellfish production.
- 13. Discharge shall not occur in a designated National Wild and Scenic River.
- 14. Discharge shall be of suitable material free from toxic pollutants in toxic amounts.
- 15. All temporary fills shall be removed in their entirety and the area restored to its original elevation.

7. BMPs FOR MINING OPERATIONS

Environmental damage can sometimes occur during the initial land-disturbing activities conducted at mining operations. The potential for such damage can be substantially reduced with the installation of BMPs. The basic objective of reclamation of a mine site is to establish on a continuing basis the vegetative cover, soil stability, and water and safety conditions appropriate to the area.

The BMPs are performance-oriented, allowing a mining applicant to design and propose the most economical and effective means of:

- a) controlling erosion and preventing off-site sedimentation damage;
- b) preventing contamination of surface waters and groundwater; and
- c) preventing any condition that will have unduly adverse effects on wildlife or freshwater, estuarine or marine fisheries.

BMP selection is site-specific and controlled by on-site conditions. The acceptability of a BMP is therefore based upon the characteristics of the individual site and its potential for off-site damage.

The following table provides a list of BMPs used for activities associated with mining activities in North Carolina. This list is essentially the same as that provided for Sedimentation and Erosion Control, due to the similar nature of activities in both programs.

- Check Dam
- Construction Road Stabilization
- Dust Control
- Grade Stabilization Structure
- Grass-Lined Channel
- Grass Channels with Liner
- Groundwater Monitoring Wells
- Land Grading
- · Level Spreader
- Mulching
- Outlet Stabilization Structure
- Paved Flume (Chutes)
- Perimeter Dike
- Permanent Diversions
- Permanent Seeding
- Permanent Stream Crossing
- Pipe Inlet Protection (Horseshoe Filter)
- Right-of-Way Diversions
- Riprap
- Riprap-Lined Channels

- Rock Dam
- Sand Fence (Wind Fence)
- Sediment Basin
- Sediment Fence
- Sodding
- Structural Streambank Stabilization
- Subsurface Drain
- Surface Roughening
- Temporary Diversions
- Temporary Gravel Construction Entrance/Exit
- Temporary Sediment Trap
- Temporary Seeding
- Temporary Slope Drains
- Temporary Stream Crossing
- Topsoiling
- Tree Preservation and Protection
- Trees, Shrubs, Vines & Ground Covers
- Vegetative Dune Stabilization
- Vegetative Streambank Stabilization

8. BMPs FOR HYDROLOGIC MODIFICATION (RELATED TO MINING OPERATIONS)

BMPs for Discharges of Dredged or Fill Material (Adapted from 40 CFR 230 - Guidelines for Specification of Disposal Sites for Dredged or Fill Material) are provided below.

1. Actions concerning the location of the discharge.

- Minimize smothering of organisms.
- Avoid disruption of periodic water inundation patterns.
- Select a previously used disposal site.
- Select a disposal site with substrate similar in composition to the material being disposed.
- Minimize extent of any plume.
- Minimize or prevent creation of standing water in areas of normally fluctuating water levels.

2. Actions concerning the material to be discharged.

- Maintain physiochemical conditions, and reduce potency and availability of pollutants.
- Limit solid, liquid and gaseous components.
- Add treatment substances.
- Utilize chemical flocculants in diked disposal areas.

3. Actions controlling the materials after discharge.

- · Reduce potential for erosion, slumping or leaching by
- using containment levees, sediment basins and cover crops to reduce erosion.
- using lined containment areas to reduce leaching.
- Cap in-place contaminated material with clean material.
- Prevent point and nonpoint sources of pollution.
- Time the discharge to minimize impact, especially during unusual high water flows, wind, wave and tidal actions.

4. Actions affecting the method of dispersion.

- Maintain natural substrate contours and elevation.
- Minimize undesirable obstruction to the water current or circulation pattern.
- Confine suspended particulate/turbidity to a small area where settling can occur.
- Mix, dilute and disperse the discharge.
- Minimize water column turbidity.
- Maintain light penetration for organisms.
- Set limitations on the amount of material discharged per unit of time or volume.

5. Actions related to technology.

- Use appropriate equipment and machinery, including protective devices.
- Employ appropriate operation and maintenance of machinery, including training, staffing and working procedures.
- Use machinery and techniques designed to reduce damage to wetlands, including devices that scatter rather than mound
 excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machinery to reduce
 compaction and rutting.
- Design access roads and channel spanning structures to accommodate fluctuating water levels and circulation patterns.

6. Actions affecting plant and animal populations.

- Avoid changes in water current and circulation patterns.
- Prevent or avoid creating habitat conducive to the development of undesirable predators or species.
- Avoid sites having unique habitat or other value, including endangered or threatened species.
- Institute habitat development and restoration.
- Avoid spawning or migration seasons and other biologically critical time periods.
- Avoid destruction of remnant natural sites within areas already affected by development.

7. Actions affecting human use.

- Prevent or minimize damage to the features of an aquatic site.
- Avoid disposal sites valuable as natural aquatic areas.
- Avoid seasons or periods when human recreational activity associated with the aquatic site is most important.
- Avoid sites that will increase incompatible human activity or require frequent dredge or fill maintenance in remote fish and wildlife
 areas.
- Locate disposal site outside of the vicinity of a public water supply intake.

APPENDIX 3

GLOSSARY

GLOSSARY

The minimum average flow for a period of 30 days that has an average

recurrence of one in two years.

7Q10 The lowest average flow for a seven-day period that is expected to occur once

every ten years. The 7Q10 flow is used to allocate the discharge of toxic substances to a stream. 7Q10 flows are typically obtained from the US

Geological Survey.

B (Class B) Class B Water Quality Classification. This classification denotes freshwaters

protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other

human contact such as skin diving and water skiing.

BMPs See best management practices.

BOD Biochemical Oxygen Demand. A measure of the amount of oxygen consumed

by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD

that may be discharged.

basin The watershed of a major river system. There are 17 major river basins in North

Carolina.

Benthic

macroinvertebrates (invertebrate), that live in or on the bottom of rivers and streams (benthic).

Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for

Aquatic organisms, visible to the naked eye (macro) and lacking a backbone

more information.

benthos A term for bottom-dwelling aquatic organisms.

best management

practices

Techniques that are determined to be currently effective practical means of

preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures and other practices. BMPs are applied as a system of practices, not just one at a time.

bioclassification A rating of water quality based on the outcome of benthic macroinvertebrate

sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and

Excellent.

C (Class C) Class C Water Quality Classification. This classification denotes freshwaters

protected for secondary recreation, fishing, wildlife, fish and aquatic life

propagation and survival, and others uses.

chlorophyll a A chemical constituent in plants that gives them their green color. High levels

of chlorophyll a in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or

eutrophication.

coastal counties Twenty counties in eastern NC subject to requirements of the Coastal Area

Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and

Washington.

Coastal Plain One of three major physiographic regions in North Carolina. Encompasses the

eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).

Conductivity A measure of the ability of water to conduct an electrical current. It is dependent

on the concentration of dissolved ions such as sodium, chloride, nitrates,

phosphates and metals in solution.

DENR Department of Environment and Natural Resources.

DO Dissolved oxygen.

DWQ North Carolina Division of Water Quality, an agency of DENR.

degradation The lowering of the physical, chemical or biological quality of a waterbody

caused by pollution or other sources of stress.

drainage area An alternate name for a watershed.

dystrophic Naturally acidic (low pH), "black-water" lakes which are rich in organic matter.

Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not

appropriate for evaluating dystrophic lakes.

EMC Environmental Management Commission.

EPA United States Environmental Protection Agency.

EPT Index This index is used to judge water quality based on the abundance and variety of

three orders of pollution sensitive aquatic insect larvae: Ephemeroptera

(mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).

effluent The treated liquid discharged from a wastewater treatment plant.

eutrophic Elevated biological productivity related to an abundance of available nutrients.

Eutrophic lakes may be so productive that the potential for water quality

problems such as algal blooms, nuisance aquatic plant growth and fish kills may

occur.

eutrophication The process of physical, chemical or biological changes in a lake associated

with nutrient, organic matter and silt enrichment of a waterbody. The

corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and

result in taste and odor problems.

FS Fully supporting. A rating given to a waterbody that fully supports its

designated uses and generally has good or excellent water quality.

fall line A geologic landscape feature that defines the line between the piedmont and

coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.

GIS Geographic Information System. An organized collection of computer

hardware, software, geographic data and personnel designed to efficiently

capture, store, update, manipulate, analyze and display all forms of

geographically referenced information.

HQW High Quality Waters. A supplemental surface water classification.

HU Hydrologic unit. See definition below.

habitat degradation Identified where there is a notable reduction in habitat diversity or change in

habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and

streambed scour.

headwaters Small streams that converge to form a larger stream in a watershed.

Hydrilla The genus name of an aquatic plant - often considered an aquatic weed.

hydrologic unit A watershed area defined by a national uniform hydrologic unit system that is

sponsored by the Water Resources Council. This system divides the country

into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.

hypereutrophic Extremely elevated biological productivity related to excessive nutrient

availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish

kills and excessive aquatic plant growth.

impaired Term that applies to a waterbody that has a use support rating of partially

supporting (PS) or not supporting (NS) its uses.

impervious Incapable of being penetrated by water; non-porous.

Kg Kilograms. To change kilograms to pounds multiply by 2.2046.

lbs Pounds. To change pounds to kilograms multiply by 0.4536.

loading Mass rate of addition of pollutants to a waterbody (e.g., kg/yr.)

mg/l Milligrams per liter (approximately 0.00013 oz/gal).

MGD Million Gallons Per Day.

macroinvertebrates Animals large enough to be seen by the naked eye (macro) and lacking

backbones (invertebrate).

macrophyte An aquatic plant large enough to be seen by the naked eye.

mesotrophic Moderate biological productivity related to intermediate concentrations of

available nutrients. Mesotrophic lakes show little, if any, signs of water quality

degradation while supporting a good diversity of aquatic life.

NCIBI North Carolina Index of Biotic Integrity. A measure of water quality factors

affecting the fish in a given waterbody.

NH₃-N Ammonia nitrogen.

NPDES National Pollutant Discharge Elimination System.

NPS Nonpoint source.

NR Not rated. A waterbody that is not rated for use support due to insufficient data.

NS Not supporting. A rating given to a waterbody that does not support its

designated uses and has poor water quality and severe water quality problems.

Both PS and NS are called impaired.

NSW Nutrient Sensitive Waters. A supplemental surface water classification intended

for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan

Reservoir (including the entire Haw River watershed).

NTU Nephelometric Turbidity Units. The units used to quantify turbidity using a

turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light

scattered by a standard reference suspension under the same conditions.

nonpoint source A source of water pollution generally associated with rainfall runoff or

snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less

pollution and runoff more slowly than runoff from urban lands.

ORW Outstanding Resource Waters. A supplemental surface water classification

intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and

there are associated stormwater runoff controls enforced by DWQ.

pH A measure of the concentration of free hydrogen ions on a scale ranging from 0

to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas

values above 7 and approaching 14 indicate a more basic solution.

PS Partially supporting. A rating given to a waterbody that only partially supports

its designated uses and has fair water quality and severe water quality problems.

Both PS and NS are called impaired.

Piedmont One of three major physiographic regions in the state. Encompasses most of

central North Carolina from the Coastal Plain region (near I-95) to the eastern

slope of the Blue Ridge Mountains region.

phytoplankton Aquatic microscopic plant life, such as algae, that are common in ponds, lakes,

rivers and estuaries.

riparian zone Vegetated corridor immediately adjacent to a stream or river. See also SMZ.

river basin The watershed of a major river system. North Carolina is divided into 17 major

river basins. These include the Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River

basins.

river system The main body of a river, its tributary streams and surface water impoundments.

runoff Rainfall that does not evaporate or infiltrate the ground, but instead flows across

land and into waterbodies.

SA Class SA Water Classification. This classification denotes saltwaters that have

sufficient water quality to support commercial shellfish harvesting.

SB Class SB Water Classification. This classification denotes saltwaters with

sufficient water quality for frequent and/or organized swimming or other human

contact.

SC Class SC Water Classification. This classification denotes saltwaters with

sufficient water quality to support secondary recreation and aquatic life

propagation and survival.

Sw Swamp Waters. A supplemental surface water classification denoting waters

that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored

giving rise to their nickname of "blackwater" streams.

sedimentation The sinking and deposition of waterborne particles (e.g., sediment, algae and

dead organisms).

Silviculture Care and cultivation of forest trees; forestry.

streamside The area left along streams to protect streams from sediment and other

management pollutants, protect streambeds, and provide shade and woody debris

zone (SMZ) for aquatic organisms.

subbasin A designated subunit or subwatershed area of a major river basin. Subbasins

typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There

are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources

Council (see *hydrologic unit*).

TMDL Total maximum daily load. The amount of a given pollutant that a waterbody

can assimilate and maintain its uses.

Total nitrogen. TN

TP Total phosphorus.

TSS Total Suspended Solids.

tributary A stream that flows into a larger stream, river or other waterbody.

trophic classification Trophic classification is a relative description of a lake's biological productivity,

> which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes

are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic."

turbidity An expression of the optical property that causes light to be scattered and

absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of

leaves contribute to instream turbidity.

UT Unnamed tributary. The region, or land area, draining into a body of water (such

> as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as

a basin or river basin.

WET Whole effluent testing. The aggregate toxic effect of a wastewater measured

directly by an aquatic toxicity test.

WS Class WS Water Supply Water Classification. This classification denotes

> freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or

wastewater discharges like WS-I through WS-IV.

watershed

The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.

WWTP

Wastewater treatment plant.

REFERENCES

REFERENCES

- Alabaster, J.S. and R. Lloyd. 1982. Water Quality Criteria for Freshwater Fish. Second Edition.
- Bergman, H.L. and Dorward-King, E.J. 1997. *Reassessment of Metals Criteria for Aquatic Life Protection: Priorities for Research and Implementation*. SETAC Pellston Workshop on Reassessment of Metals for Aquatic Life Protection. 1996 Feb 10-14. Pensacola, FL. SETAC Pr. 114p.
- Center for Watershed Protection. 1995. Blueprint to Protect Coastal Water Quality: A Guide to Successful Growth Management in the Coastal Region of North Carolina. Report prepared for the Neuse River Council of Governments under an EPA 205(j) grant administered by the NC Division of Environmental Management.
- Dohrmann, J. 1995. *The Puget Sound Water Quality Initiative A Case Study in Using the Tools I.* pp 119-120 in Proceedings 4th National Watershed Conference. Charleston, WV. National Watershed Coalition. Lakewood, Colorado.
- Duda, A.M. and K.D. Cromartie. 1982. *Coastal Pollution from Septic Tank Drainfields*. Journal of the Environmental Engineering Division. ASCE. 108:1265-1279.
- Eagleson, Kenneth W., David L. Lenat, Larry W. Ausley and Ferne Winborne. 1990. Comparison of Measured Instream Biological Responses with Responses Predicted Using the Ceriodaphnia Chronic Toxicity Test. Env. Toxicol. and Chem. Vol. 9, No. 8. pp 1019-1028.
- Encarta Encyclopedia Online. *Pollution*. http://encarta.msn.com/find/concise.asp?ti=761570933&sid=4#s4 (May 22, 2000).
- Herring, J. 1996. A Private Market Approach to On-Site Wastewater Treatment System Maintenance. The Small Flows Journal. 2:1:16-24.
- Howell, J.M., M.S. Coyne and P.L. Cornelius. 1996. Effect of Sediment Particle Size and Temperature on Fecal Bacteria Mortality Rates and the Fecal Coliform/Fecal Streptococci Ratio. J Environ Qual. 21:1216-1220.
- Lenat, D.R., D.L. Penrose and K.W. Eagleson. 1979. *Biological Evaluation of Nonpoint Source Pollutants in North Carolina Streams and Rivers*. North Carolina Department of Natural Resources and Community Development. Biological Series 102. Raleigh, NC.
- Maryland Cooperative Extension. *Riparian Buffer Management: Riparian Forest Buffer Design*, *Establishment, and Maintenance*. Fact Sheet 725. http://www.agnr.umd.edu/ces/pubs/html/fs725/fs725.html. University of Maryland. College Park, MD. 1999

- Mulholland, Patrick J. and David R. Lenat. 1992. Streams of the Southeastern Piedmont, Atlantic Drainage, in Biodiversity of Southeastern United States/Aquatic Communities. John Wiley & Sons, Inc.
- NCDEM. 1991. *An Evaluation of the Effects of the North Carolina Phosphate Detergent Ban.* Report No. 91-04. February.
- North Carolina Cooperative Extension Service. *Improving Septic Systems: Is Your Well Protected From Your Septic System?* Environmental Stewardship for Farmers 4. http://ces.soil.ncsu.edu/soilscience/publications/farmassist/Septic/. Raleigh, NC.
- Press, Frank and R. Siever. 1994. *Understanding Earth*. W.H. Freeman and Company.
- Schillinger, J.E. and J.J. Gannon. 1985. *Bacterial Adsorption and Suspended Particles in Urban Stormwater*. Journal WPCF. 57:384-389.
- Schueler, Tom. 1994. *The Importance of Imperviousness*. Watershed Protection Techniques. Vol. 1, No. 3. Fall 1994.
- Sherer, B.M., J.R. Miner, J.A. Moore and J.C. Buckhouse. 1992. *Indicator Bacterial Survival in Stream Sediments*. J Environ Qual. 21:591-595.
- Tschetter P. and J. Maiolo. 1984. Social and Economic Impacts of Coastal Zone Development on the Hard Clam and Oyster Fisheries in North Carolina. Working Paper 84-3. UNC Sea Grant Publication. UNC-SG-WP-84-3.
- US Environmental Protection Agency. 1993b. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Areas*. 840-B-92-002. Office of Water.
- US Environmental Protection Agency. *Index of Watershed Indicators*. http://www.epa.gov/iwi/. Office of Water. Washington, DC.